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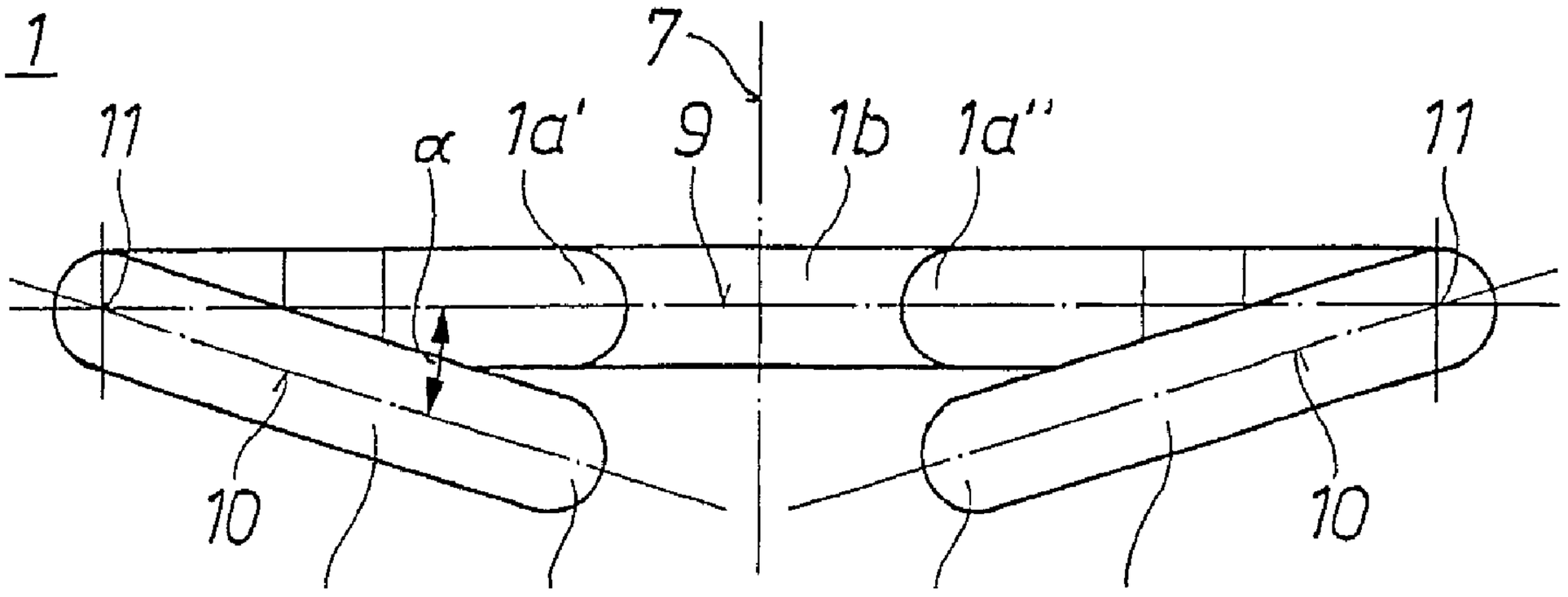
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(54) Titre : DISPOSITIF DE FIXATION DES RAILS ELASTIQUE A AJUSTEMENT SERRE POUR SYSTEME DE VOIE FERREE

(54) Title: FRICTION-FIT ELASTIC RAIL FASTENER FOR TRACK SYSTEMS



(57) Abrégé/Abstract:
The invention relates to a rail connection for track systems, which comprises a tensioning element (1) made of an elastic material, in particular a hardened spring steel, which is deposited in such a manner in the mounted state, between a maintaining plate (3) which is arranged on a threshold (2) and a fastening anchor (4), such that it exerts a maintaining force upon the base (5) of a rail (6) in order to maintain the rail (6) in position. The tensioning element (1) is embodied in a symmetrical manner in relation to a symmetrical plane (7) which is oriented in a vertical manner, said symmetrical plane being perpendicular on the longitudinal axis (8) of the rail (6). According to the invention, the tensioning element (1) comprises two torsion limbs (1a', 1a'') which extend preferably, essentially in a parallel manner in relation to each other in order to obtain stepped overload protection. Both of the torsion limbs (1a', 1a'') are connected together on the side oriented away from the rail (6) by means of a connecting section (1 b), and a loop-shaped clamping section (1d', 1d'') is arranged on the end (1c', 1c'') of the torsion limb (1 a', 1 a'') which is oriented away from the rail (6). The torsion limb (1a', 1a'') together with the connecting section (1b) is arranged, essentially, on a first plane (9) when the tensioning element (1) is not in the tensioned state and at least one part of the loop-shaped clamping section (1d', 1d'') is arranged on a second plane (10). The second plane (10) is rotated about an axis (11) in relation to the first plane (9), which extends in a parallel manner on the sectional axis of the symmetrical plane (7) with the first plane (9).

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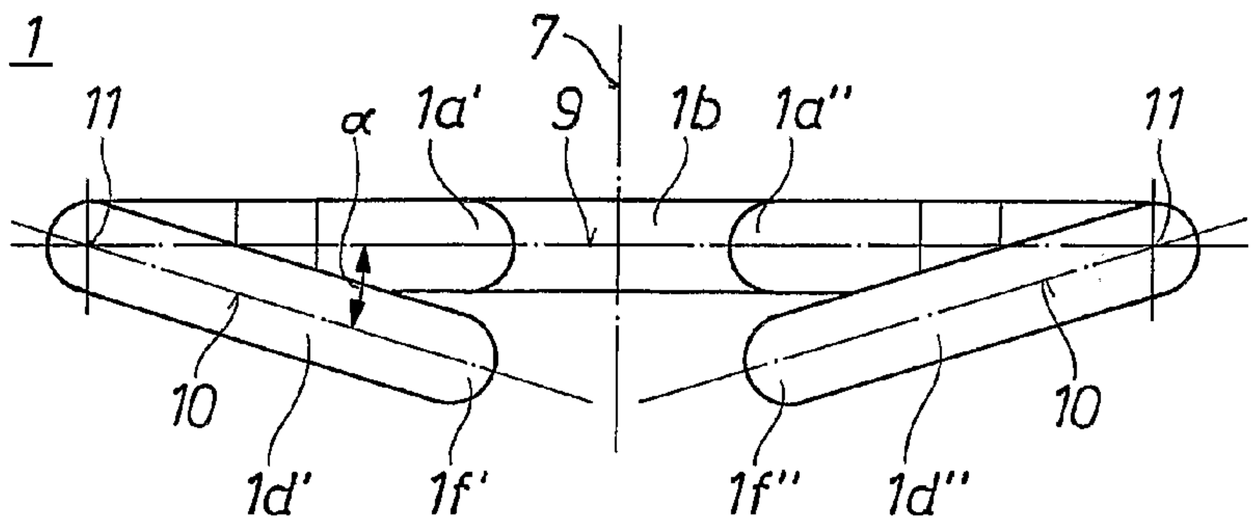
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(54) Title: NON-POSITIVE FIT ELASTIC RAIL CONNECTION FOR TRACK SYSTEMS

(54) Bezeichnung: KRAFTSCHLÜSSIG-ELASTISCHE SCHIENBEFESTIGUNG FÜR GLEISANGEN



(57) Abstract: The invention relates to a rail connection for track systems, which comprises a tensioning element (1) made of an elastic material, in particular a hardened spring steel, which is deposited in such a manner in the mounted state, between a maintaining plate (3) which is arranged on a threshold (2) and a fastening anchor (4), such that it exerts a maintaining force upon the base (5) of a rail (6) in order to maintain the rail (6) in position. The tensioning element (1) is embodied in a symmetrical manner in relation to a symmetrical plane (7) which is oriented in a vertical manner, said symmetrical plane being perpendicular on the longitudinal axis (8) of the rail (6). According to the invention, the tensioning element (1) comprises two torsion limbs (1a', 1a") which extend preferably, essentially in a parallel manner in relation to each other in order to obtain stepped overload protection. Both of the torsion limbs (1a', 1a") are connected together on the side oriented away from the rail (6) by means of a connecting section (1 b), and a loop-shaped clamping section (1d', 1d") is arranged on the end (1c', 1c") of the torsion limb (1 a', 1 a") which is oriented away from the rail (6). The torsion limb (1a', 1a") together with the connecting section (1b) is arranged, essentially, on a first plane (9) when the tensioning element (1) is not in the tensioned state and at least one part of the loop-shaped clamping section (1d', 1d") is arranged on a second plane (10). The second plane (10) is rotated about an axis (11) in relation to the first plane (9), which extends in a parallel manner on the sectional axis of the symmetrical plane (7) with the first plane (9).

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Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(57) Zusammenfassung: Die Erfindung betrifft eine Schienenbefestigung für Gleisanlagen, die ein Spannelement (1) aus elastischem Material, insbesondere aus gehärtetem Federstahl, aufweist, das im montierten Zustand zwischen einer an einer Schwelle (2) angeordneten Halteplatte (3) und einem Befestigungsanker (4) so festgelegt ist, dass es auf den Schienenfuß (5) einer Schiene (6) eine Haltekraft ausübt, um die Schiene (6) in Position zu halten, wobei das Spannelement (1) zu einer vertikal ausgerichteten Symmetrieebene (7), die senkrecht auf der Längsachse (8) der Schiene (6) steht, symmetrisch ausgebildet ist. Um einen gestuften Überlastschutz zu erzielen, ist erfindungsgemäß vorgesehen, dass das Spannelement (1) zwei, vorzugsweise im wesentlichen parallel zueinander verlaufende, Torsionsschenkel (1 a', 1 a") aufweist, wobei die beiden Torsionsschenkel (1 a', 1 a") an der von der Schiene (6) abgewandten Seite durch einen Verbindungsabschnitt (1 b) miteinander verbunden sind, und dass am der Schiene (6) zugewandten Ende (1 c', 1 c") der Torsionsschenkel (1 a', 1 a") je ein schlaufenförmiger Klemmabschnitt (1 d', 1 d") angeordnet ist, wobei im nicht gespannten Zustand des Spannelements (1) die Torsionsschenkel (1 a', 1 a") samt Verbindungsabschnitt (1b) im wesentlichen in einer ersten Ebene (9) liegen und zumindest ein Teil der schlaufenförmigen Klemmabschnitte (1 d', 1 d") in einer zweiten Ebene (10) liegen, wobei die zweite Ebene (10) gegenüber der ersten Ebene (9) um eine Achse (11) verdreht ist, die parallel zur Schnittachse der Symmetrieebene (7) mit der ersten Ebene (9) verläuft.

Friction-fit elastic rail fastener for track systems

The invention relates to a friction-fit elastic rail fastener for track systems, comprising a tensioning element made of an elastic material, in particular hardened spring steel, that in the assembled state is fixed in place between a retaining plate provided on a sleeper and a fastening anchor such that the tensioning element exerts a retention force on the rail foot in order to hold the rail in position, and the tensioning element is symmetrically aligned with respect to a vertically oriented plane of symmetry that is perpendicular to the longitudinal axis of the rail.

A generic rail fastener is known from DE 34 00 110 [US 4,770,343]. In the cited document a tensioning element is used that in the assembled state is provided between a retaining plate and a fastening anchor. The tensioning element has two legs designed as torsion elements. The torsion legs have two adjacent parallel spring bar sections that are formed one piece with a loop that forms a bracing section and is curved outward and essentially transversely with respect to the spring bar sections. The two spring bar sections of the torsion legs are connected via the transverse connecting piece. The two outer spring bar sections of the torsion legs each have a U-shaped bend, provided at a distance behind the transverse connecting piece that at its free end section is supported on the transverse connecting piece, whereas anchor parts for the rail fastener have two support flanges for the torsion legs of the tensioning element, projecting toward opposite

sides, adjacent to a center bar and respectively provided at a distance above stop bevels for the bracing sections located next to the rail foot.

A rail fastener of the above-described type is known from DE 39 18 091 [5,096,119] in which sections of the outer legs of the epsilon-shaped tensioning elements widen toward the rail foot with an increase in distance between the inner legs. The mutually aligned free ends of the tensioning element end outside the inner legs. The tensioning element is also designed such that in the assembled position a center bar comes to rest a small distance above the rail foot, and in the preassembled position the inner side of the center bar contacts the shaft of the sleeper screw.

In one of the previously known embodiments, although the tensioning element fulfills its function, namely, to securely hold the rail on the sleeper, the tensioning element is relatively large and complicated in design. This entails a correspondingly high level of manufacturing complexity that increases the production costs for the tensioning elements.

In addition, the previously known tensioning elements do not adequately address the problem that the rail may tilt when unusually high forces impinge thereon. The torsion legs of the tensioning element and the sleeper screws may be highly stressed, i.e. overtightened or overloaded, when the rail tilts. It is therefore desirable to design the rail fastener in such a way that precautions are taken, and also that overloading of the tensioning element and of the sleeper screws is prevented even during tilting.

In one of the previously known embodiments, the tensioning torque is indirectly produced only by tightening the sleeper screws or hook screws. The tensioning force of the tensioning element also acts on the pretensioning force of the sleeper screw, thereby also subjecting the screw to load. In addition, the tensioning element can be assembled only by use of a sleeper screw or hook screw. It is desirable to achieve a universal assembly of the tensioning element, i.e. with or without screws, and, if necessary, without affecting the pretensioning force for the screw.

The object of the invention, therefore, is to refine a rail fastener of the generic type such that the above-referenced disadvantages are avoided, that in particular a simple geometric design of the tensioning element is possible, and that the associated manufacturing costs remain low. A further aim is to provide a reliable two-stage overload protection so that the tensioning element is not damaged even when occasional, unusually high forces arise. A further aim is to provide a possibility for assembly that is universal and, if necessary, independent from the screw pretensioning.

Achievement of this object according to the invention is characterized in that the tensioning element has two preferably parallel torsion legs that in the assembled state are at least substantially provided between the retaining plate and the fastening anchor, and the two torsion legs are connected to one another on the side facing away from the rail by means of a connecting section. In addition, a loop-shaped clamping section is

provided on each end of the torsion leg facing the rail, and adjacent the torsion legs the clamping section first extends essentially perpendicular to the plane, and then extends in a looped manner until the ends of the clamping section reach the vicinity of the ends of the torsion legs, where they form a support surface on the rail foot. Furthermore, in the non-tensioned state of the tensioning element the torsion legs together with the connecting section lie essentially in a first plane, and at least a portion of the loop-shaped clamping sections lie in a second plane, whereby the second plane is rotated about an axis in relation to the first plane, the axis extending parallel to the sectional axis of the plane of symmetry containing the first plane.

In the assembled state of the tensioning element, the second plane preferably is substantially congruent with the first plane.

Under normal load on the rail, in the assembled state the loop-shaped clamping sections of the tensioning element preferably contact the rail foot. However, the ends of the clamping section in the assembled state may also engage in recesses provided for same in the retaining plate. In this manner it is possible for the end-face ends of the clamping sections to lock in the recesses for horizontal stabilization in the final assembled position. The recesses in the retaining plate may also have locking projections or catches that enable the ends of the clamping section to engage with the retaining plate.

The loop-shaped clamping sections may also first extend from the end of the torsion legs, essentially perpendicular to the

plane of symmetry, and then extend in the direction away from the rail in order to return back to the rail in a curved progression. In this case, the loop-shaped clamping sections preferably have an S-shaped curve, at least in places. This design provides a compact structure of the fastening system, as discussed further below.

In their portions facing the rail as viewed from above, the loop-shaped clamping sections preferably each have an essentially circular or oval shape. Connection transitions between the individual functional zones are provided with large radii or radius transitions to ensure optimal tension curves in the material of the tensioning element. The individual radii or radius transitions along the curve of the tensioning element may have different sizes.

The loop-shaped clamping sections adjacent the torsion legs may first extend essentially perpendicular from the plane of symmetry.

The angle between the above-referenced planes, i.e. between the first plane and the second plane, is preferably between 5° and 30° in the non-tensioned state of the tensioning element.

The ends of the loop-shaped clamping sections may be designed as straight sections. These straight sections preferably extend parallel to each other.

The ends of the loop-shaped clamping sections, in particular the straight sections, may have a cutout that is designed as a support surface on the corner radius of the rail foot. This allows defined and secure contact on the rail foot.

To accommodate an overload, each loop-shaped clamping section may have a first contact surface in the lateral region of the clamping section for contacting the rail foot, the first contact surface likewise contacting the rail foot when the rail tilts in the event of high horizontal forces on the rail head (first overload case), but with a greatly reduced lever arm. In addition, each loop-shaped clamping section may have a second contact surface for contacting the fastening anchor, and in a second, more intense overload case that exceeds the first overload case for the forces acting on the rail, the second contact surface contacts the fastening anchor.

The retaining plate may be integrated into a rail-bed plate.

The retaining plate and the fastening anchor may have a two-piece design. The retaining plate and the fastening anchor may be connected or held together by means of a hook screw.

The fastening anchor may be plate-shaped and fixed in placed by a screw.

The retaining plate and the fastening anchor may also have a one-piece design.

On its lower face, in its lateral end regions facing the rail, the fastening anchor may have contact surfaces for the loop-shaped clamping sections. On its lower face the fastening anchor in its lateral end regions facing away from the rail may also have a first channeled locking depression in each case for locking the tensioning element in a preassembled position. On its lower face the fastening anchor may also have a second channeled locking

depression in its lateral end regions facing away from the rail for locking the tensioning element in a neutral position. Finally, on its lower face the fastening anchor may have two channeled contact surfaces for supporting the torsion legs of the tensioning element in the final assembled state.

The fastening anchor may also be formed by the sleeper screw or by a washer connected thereto.

The retaining plate may have two curved depressions, extending perpendicular to the longitudinal axis of the rail, for guiding the tensioning element during installation thereof. The retaining plate may have two contact surfaces for contacting the tensioning element in its assembled state. Furthermore, on its lower face the retaining plate may have a projection, extending in the direction of the longitudinal axis of the rail, for engaging with a corresponding recess in the sleeper.

The tensioning element may be economically produced by use of the proposed design. The tensioning element is relatively compact, so that the proposed rail fastener may be used for a number of applications.

In addition, two-stage overload protection of the rail fastener is provided in the event of overload, thereby reliably preventing excessive tilting of the rail and avoiding plastic deformation of the clamp.

Illustrated embodiments of the invention are shown in the drawings that show the following:

FIG. 1 shows a perspective view of a friction-fit elastic fastener for a rail in a track system;

FIG. 2 shows a top view of the system according to FIG. 1;

FIG. 3 shows a perspective view of an exploded illustration of the rail fastener according to FIG. 1;

FIG. 4 shows the exploded illustration according to FIG. 3 in a view from below;

FIG. 5 shows a top view of the non-tensioned tensioning element for the rail fastener;

FIG. 6 shows a front view (view A according to FIG. 5) of the tensioning element;

FIG. 7 shows a view corresponding to FIG. 6, from a lower viewing angle;

FIG. 8 shows a side view (view B according to FIG. 5) of the tensioning element;

FIG. 9 shows a perspective view of the tensioning element in a view from above;

FIG. 10 shows a perspective view of the tensioning element in a view from below;

FIG. 11 shows a perspective view of the retaining plate for the rail fastener in a view from above;

FIG. 12 shows a perspective view of the retaining plate according to FIG. 11 in a view from below;

FIG. 13 shows a perspective view of the fastening anchor for the rail fastener in a view from above;

FIG. 14 shows a perspective view of the fastening anchor according to FIG. 13 in a view from below;

FIG. 15 shows a side view of the rail fastener during a first stage of assembly, namely, in the preassembled stage;

FIG. 16 shows a side view of the rail fastener during a second stage of assembly, namely, in the neutral position;

FIG. 17 shows a side view of the rail fastener during a third stage of assembly, namely, in the intermediate stage position;

FIG. 18 shows a side view of the rail fastener after assembly is complete;

FIG. 19 shows an illustration of the overload protection corresponding to FIG. 18 for preventing the rail from tilting under excessive horizontal forces on the rail head;

FIG. 20 shows a perspective view of the retaining plate for the rail fastener in a view from above, together with recesses for the ends of the tensioning element;

FIG. 21 shows a perspective view of the retaining plate together with the fastening anchor in a one-piece design;

FIG. 22 shows an alternative embodiment of the one-piece design of the retaining plate and fastening anchor, together with a concrete sleeper anchor;

FIG. 23 shows a rail-bed plate having an integrated retaining plate and fastening anchor;

FIG. 24 shows a rail fixed to a rail-bed plate according to FIG. 23 by means of a tensioning element;

FIG. 25 shows an alternative embodiment to FIG. 24, having a separately attached fastening anchor, the attachment being provided by a hook screw;

FIG. 26 shows an arrangement according to FIG. 25 in partial section in a view from below;

FIG. 27 shows an alternative embodiment of the invention having a slide chair plate for the point switch region;

FIG. 28 shows a perspective view of a tensioning element having an alternative design;

FIG. 29 shows a top view of the tensioning element according to FIG. 28;

FIG. 30 shows a side view,

FIG. 31 shows a top view, and

FIG. 32 shows a perspective illustration of a rail fastener in which the fastening anchor is formed by a sleeper screw, specifically, in a preassembled position;

FIG. 33 shows a side view,

FIG. 34 shows a top view, and

FIG. 35 shows a perspective illustration of the rail fastener according to FIGS. 30 through 32, specifically, in the final assembled position;

FIG. 36 shows a perspective view of an alternative design of the tensioning element in a view from above;

FIG. 37 shows a front view (view A according to FIG. 36) of the tensioning element according to FIG. 36);

FIG. 38 shows a side view (view B according to FIG. 36) of the tensioning element according to FIG. 36;

FIG. 39 shows a perspective illustration of the rail fastener together with the tensioning element according to FIGS. 36 through 38, in the final assembled position;

FIG. 40 shows a perspective view of a further alternative design of the tensioning element in a view from above;

FIG. 41 shows a top view of the tensioning element according to FIG. 40;

FIG. 42 shows a side view of the tensioning element according to FIG. 40;

FIG. 43 shows a side view of the rail fastener together with the tensioning element according to FIGS. 40 through 42, in the final assembled position;

FIG. 44 and

FIG. 45 show the perspective illustration of the rail fastener together with the tensioning element according to FIGS. 40 through 42 from two different viewing directions, in the final assembled position;

FIG. 46 shows a perspective view of a further alternative design of the tensioning element in a view from above;

FIG. 47 shows a perspective view of the tensioning element according to FIG. 46 from another viewing direction;

FIG. 48 shows a side view of the tensioning element according to FIG. 46 or 47;

FIG. 49 shows a side view of the rail fastener together with the tensioning element according to FIGS. 46 through 48, in the final assembled position; and

FIG. 50 and

FIG. 51 show the perspective illustration of the rail fastener together with the tensioning element according to FIGS. 46

through 48 from two different viewing directions, in the final assembled position.

FIGS. 1 through 4 show the basic structure of a friction-fit elastic rail fastener for a track system. The rail 6 must be fastened to a sleeper 2 or a rail-bed plate (see FIG. 23). For this purpose, the sleeper 2 is formed with a recess 24 whose shape corresponds to a projection of a retaining plate 3 mounted on the sleeper 2. The recess 24 may correspond to the shape of a known angled guide plate, or may have another design. A plate-shaped fastening anchor 4 is fixed to the retaining plate 3 and the sleeper 2 by means of a sleeper screw 12. A tensioning element 1 is provided between the fastening anchor 4 and the retaining plate 3 and in its assembled state exerts a pressure force on the rail foot 5 and thus holds the rail 6 in the intended position.

As shown in FIG. 2, the tensioning element 1 has a symmetrical design with a vertical axis of symmetry 7 extending perpendicular to the longitudinal axis 8 of the rail 6.

The specific design of the tensioning element 1 is shown in FIGS. 5 through 10.

As shown most clearly in FIG. 5, the tensioning element 1 comprises two torsion legs 1a' and 1a" that are symmetrical with respect to the plane of symmetry 7 and parallel to each other. The torsion legs are connected to one another via a connecting section 1b. Loop-shaped clamping sections 1d' and 1d" is provided on the respective ends 1c' or 1c" of the torsion legs 1a' and 1a"; i.e. the torsion leg 1a' and 1a" merges into the clamping section 1d' and 1d" via a rounded section. The clamping section 1d' and 1d"

each have an essentially circular or oval shape in the top view of the tensioning element 1 (see FIG. 5). The clamping section 1d' and 1d" extend in a circular configuration until reaching their ends 1e' and 1e" that come to rest in the vicinity of the ends 1c' and 1c" of the torsion legs 1a' and 1a".

This and regions 1e' and 1e" are designed as straight sections 1f' and 1f", and are provided for pressing on the top side of the rail foot 5 in normal operation. As shown in FIGS. 7, 8, and 10, for this purpose cutouts 1g' and 1g" are provided in the tensioning element 1, namely, in the straight sections 1f' and 1f", so that in the region of the straight sections 1f' and 1f" the tensioning element 1 lies flat (not just in selected locations) on the corner radius of the rail foot 5.

As shown most clearly in FIG. 6, the two torsion legs 1a' and 1a" together with the connecting section 1b lie essentially in a first plane 9. Portions of the clamping sections 1d' and 1d", however, lie in a second plane 10 that is rotated with respect to the plane 9 about the axis 11 by the angle α. The axis 11 is parallel to the sectional axis of the plane of symmetry 7 containing the first plane 9, and in FIG. 6 is thus perpendicular to the plane of the drawing. The angle α is 5° to 30° in the non-tensioned or partially tensioned state.

As a result of this design, after the tensioning element 1 is assembled, it makes defined contact only in the region of the straight sections 1f' and 1f". The tensioning element 1 otherwise does not contact the rail foot 5 in normal operation.

As shown in FIG. 8, the tensioning element 1 as a whole may have a slightly curved design to provide optimal cooperation with the retaining plate 3 or with the fastening anchor 4. This figure also clearly shows the manner in which the frontmost portion of the clamping section 1d' and 1d" is rotated out of the plane of the torsion legs.

The following precautions are taken to prevent damage or overload of the tensioning element 1 in the event of an excessive lateral, horizontal force on the head of the rail 6, i.e. when the rail 6 undergoes a tilting motion about its longitudinal axis 8.

First contact surfaces 1h' and 1h" are provided on the tensioning element, i.e. in the region of the loop-shaped clamping sections 1d' and 1d", in lateral regions 1i' and 1i" of the clamping sections 1d' and 1d". In the event of extreme tilting of the rail 6, the rail foot 5 also presses on these contact surfaces 1h' and 1h", thereby increasing the elastic force of the tensioning element 1 on the rail foot 5. Thus, the first stage of an overload protection is provided by the first contact surfaces 1h' and 1h".

If the tilting motion of the rail 6 should increase even more, second contact surfaces 1k' and 1k" are provided on the clamping sections 1d' and 1d" that upon further lifting of the clamping sections 1d' and 1d" are also lifted and press against contact surfaces 15' and 15" (see FIG. 14) on the fastening anchor 4. This results in high resistance to further tilting of the rail 6 without overtightening and therefore damaging the tensioning element 1.

FIGS. 11 and 12 illustrate one possible approach to the use of a retaining plate 3. On its lower face 22 the retaining plate 3 has a projection 23 whose shape corresponds to that of the recess 24 in the sleeper 2 (see FIGS. 3 and 4). This ensures precise contact of the retaining plate 3 on the sleeper 2. On its top side the retaining plate 3 has two curved depressions 20' and 20" that facilitate installation of the tensioning element 1 during assembly. In the final assembled state the tensioning element 1 rests on contact surfaces 21' and 21" on the retaining plate 3. The curved or trough-shaped depressions are useful when the tensioning element 1 is installed from the rear using an installation tool; i.e. it is not necessary to detach the fastening anchor 4. The depressions are used to push the tensioning element through from behind without great exertion of force. In the absence of the depressions, the tensioning element would have to be completely compressed to its final tensioned state when pushed through.

The fastening anchor 4 is shown in FIGS. 13 and 14. The lower face 13 of the plate-shaped fastening anchor 4 has various features that facilitate assembly and retention of the tensioning element 1 in the final assembled position. In lateral end regions 14' and 14" of the fastening anchor 4 facing the rail are located the previously mentioned contact surfaces 15' and 15" that in the second overload protection stage are contacted by the clamping sections 1d' and 1d" at the second contact sections 1k' and 1k" thereof.

During assembly the tensioning element 1 is first pushed in the direction of the rail until it rests against first channeled locking depressions 17' and 17" that are provided, i.e. integrally molded, in lateral end regions 16' and 16". When the tensioning element 1 is advanced further in the direction of the rail 6, and thus in the direction of the final position of the tensioning element after assembly, the tensioning element 1 comes to rest in second channeled locking depressions 18' and 18". In the final assembled position the tensioning element 1 then makes contact in channeled contact surfaces 19' and 19".

The assembly sequence for the rail fastener is shown in FIGS. 15 through 18:

The first stage of installation in the preassembled position is shown in FIG. 15. The fastening anchor 4 together with the retaining plate 3 is preassembled (on the track or in the sleeper unit) by means of the sleeper screw 12 that has been completely tightened. The tensioning element 1 is first installed by hand into the space between the retaining plate 3 and the fastening anchor 4. By use of an installation tool the tensioning element 1 may then be advanced further in the direction of the rail. This is done until the frontmost regions of the clamping sections 1d' and 1d" come to rest in the first channeled locking depressions 17' and 17" in the fastening anchor 4.

FIG. 16 shows the second stage of installation, the neutral position. In the neutral position the tensioning element 1 is advanced in the direction of the rail until the frontmost regions of the clamping sections 1d' and 1d" come to rest in the

second channeled locking depressions 18' and 18" in the fastening anchor 4. In this position of the tensioning element 1 the rail is prevented from tilting out during the assembly operation. A small tensioning force is produced by the tensioning element 1.

In the third stage of installation, the intermediate stage as shown in FIG. 17, the tensioning element 1 has been advanced further in the direction of the rail. This stage represents a deformation of the tensioning element between the neutral position and the final tensioning. In this position a central tensioning force is produced by the tensioning element 1, and the tensioning element is clamped between the retaining plate and the fastening anchor.

FIG. 18 shows the fourth stage of installation, the final tensioning. The tensioning element 1 now prevents the rail from tilting during operation. A sufficient final tensioning force is produced, depending on the application. The tensioning element 1 now rests or makes contact with three regions: In the vicinity of the straight sections 1f' and 1f" the tensioning element 1 presses on the rail foot 5. At the fastening anchor 4 the tensioning element 1 rests against the channeled contact surfaces 19' and 19". The retaining plate 3 contacts the tensioning element at the contact surfaces 21' and 21".

The measures for protection against overload of the tensioning element 1 are shown in FIG. 19:

In the first stage of overload protection the first contact surfaces 1h' and 1h" of the loop-shaped clamping section 1d' and 1d" of the tensioning element 1 rest on the rail foot 5.

In the first stage of overload protection the first distance, denoted by reference numeral s_1 in FIG. 19, approaches zero; i.e. contact occurs between the loop-shaped clamping section and the rail foot.

In the second stage of overload protection the loop-shaped clamping sections 1d' and 1d" together with the second contact surfaces 1k' and 1k" are supported on the contact surfaces 15' and 15" of the fastening anchor 4.

In the second stage of overload protection the second distance, denoted by reference numeral s_2 in FIG. 19, approaches zero; i.e. contact occurs between this clamping section and the fastening anchor.

In the illustrated embodiment the loop-shaped clamping sections 1d' and 1d" adjacent the torsion legs 1e' and 1e" extend away from the plane of symmetry 7. In principle, the clamping sections 1d' and 1d" may extend toward the plane of symmetry 7.

In the illustrated embodiment the retaining plate 4 [sic; 3] is designed as a separate component. The plate 4 [sic; 3] may be a component of a ribbed plate, or may be fixedly connected to the fastening anchor 4.

The illustrated assembly procedure is based on the fact that the sleeper screw 12 is tightened with final torque before the tensioning element 1 is installed. It is also possible for the sleeper screw 12 to not be (completely) tightened until the tensioning element 1 is installed, specifically, in the sleeper unit, for example; i.e. in the preassembled position before the

rail is assembled, or in the neutral or final tensioned position after the rail is assembled.

FIG. 20 shows a perspective view of the retaining plate 3 for the rail fastener, seen from above. The difference from the embodiment according to FIG. 11 is essentially that on the end of the retaining plate 3 facing the rail, recesses 25 are provided for supporting the ends 1e' of the clamping section of the tensioning element 1. The recesses 25 are thus used for fixing the tensioning element in place in the assembled state.

Such recesses 25 may also be provided for an embodiment as illustrated in FIG. 21. In this case the retaining plate 3 and the fastening anchor 4 are designed as one piece in a manner known as such. The rail in this instance is assembled or disassembled using an appropriately shaped fitting or removal claw as an installation tool.

FIG. 22 shows the embodiment according to FIG. 21; i.e. the retaining plate 3 and the fastening anchor 4 are designed as one piece, and here as well a concrete sleeper anchor 27 is provided for anchoring the system. The concrete sleeper anchor 27 may be integrally cast into a concrete sleeper in a form-fit manner.

FIG. 23 shows a rail-bed plate 28 into which the retaining plate 3 is integrated; the fastening anchor 4 once again is integrally molded as one piece. FIG. 24 shows the manner in which a rail 6 is fixed to the rail-bed plate 28 by means of the tensioning element 1. The retaining plate 3 may be integrated into the rail-bed plate 28 during manufacture of the rail-bed plate, for

example, by primary shaping (integral casting). However, the retaining plate may also be welded onto the rail-bed plate 28 as a separate part.

FIGS. 25 and 26 show an alternative embodiment. In this case, the fastening anchor 4 is designed as a separate part that is connected to the rail-bed plate 28 via a hook screw 26. The tensioning element 1 on account of its very flat shape may also be used as internal jaw or running rail tensioning in the point switch or cross frog region.

FIG. 27 shows a slide chair plate 29 for a point switch region, where the rail 6 together with the tensioning element 1 is fixed in place.

One variant of the tensioning element is shown in FIGS. 28 and 29. Here it is seen that the two torsion legs 1a' and 1a" are not parallel, but instead form a V shape together with the connecting section 1b.

The above-mentioned illustrated embodiments show that all relevant fastener variants of rail tensioning elements in use hitherto may be replaced by a tensioning element of one shape by means of the system according to the invention.

In all of the above illustrated embodiments the sleeper screw 12 fixes the fastening anchor 4 in place. However, this is not absolutely necessary. The fastening anchor 4 may be omitted, so that the sleeper screw 12 acts directly on the tensioning element and fixes same in place. To this end, FIGS. 30 through 35 show a corresponding design. The sleeper screw 12 may be connected to or have a washer. In FIGS. 30 through 32 the tensioning element

1 is still in an initial preassembled position. In FIGS. 33 through 35 the tensioning element 1 has been brought into its final assembled position. For installation, reference is made to the above description.

An alternative design of the tensioning element 1 is shown in FIGS. 36 through 38; in FIG. 39 the rail fastener together with this tensioning element 1 is seen in the final assembled position.

The difference between the embodiment of the tensioning element 1 shown by way of example in FIG. 5 and the embodiment shown in FIGS. 36 through 38 is that the loop-shaped clamping sections 1d' and 1d" have a different shape. Same as for the embodiment according to FIG. 5, the tensioning element 1 first extends from the ends 1c' and 1c" of the torsion legs 1a' and 1a", away from the plane of symmetry 7, but then extends to the rear, away from the rail 6. Only at that point does the tensioning element 1 extend in a loop, once again in the direction of the rail 6 (loop-shaped clamping section 1d' and 1d"), in order to come to rest on the rail foot 5. This results in an S-shaped curve of the loop-shaped clamping section 1d' and 1d" from the torsion legs 1a' and 1a" to the ends 1e' and 1e" of the clamping sections. In the embodiment according to FIG. 5, the transitions are straight in places (see sections 1k' and 1k" in FIG. 5).

A further difference in the embodiment illustrated in FIGS. 36 through 38 is that the support surfaces (see, for example, 1g' and 1g" in FIG. 10) have been altered. In this embodiment, the ends 1e' and 1e" on the top side of the rail foot are aligned

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obliquely to a parallel orientation with respect to the longitudinal direction of the rail 6, as shown in FIGS. 36 and 39. In the embodiment described above according to FIG. 5, the ends 1e' and 1e" are essentially at right angles to the longitudinal axis of the rail.

In the embodiment according to FIGS. 36 through 39, the support surfaces 1g' and 1g" at the ends 1e' and 1e" are slightly flattened and rest on top of the rail foot. This enlarges the support or contact surface between the tensioning element 1 and the rail foot 5, thereby preventing additional wear as the result of migration of the rail 6 in the longitudinal direction.

In the embodiment according to FIGS. 36 through 39, it is seen that a much smaller installation space is present with regard to the distance from the rail bar 30 when, for example, rail stems 31 are built on, as shown in FIG. 39. The embodiment according to FIGS. 36 through 39 therefore represents a preferred embodiment of the invention.

The variant of the tensioning element 1 illustrated in FIGS. 40 through 45 is similar to that of FIGS. 36 through 40. However, in this embodiment the ends 1e' and 1e" of the clamping section 1d' and 1d" have a different shape. In this case, the end regions 1e' and 1e" are curved inward at an angle equal to or greater than 45° (see in particular FIG. 41). The angled section 1e' and 1e", together with any flattened lower face provided, lies completely on top of the rail foot.

A further modified variant of the tensioning element 1 is shown in FIGS. 46 through 51. In this case, the loop-shaped

clamping section 1d' and 1d" is shortened; in comparison to the embodiments described above, the end region of the clamping section facing the rail 6 has been cut off so that the clamping section has only a simple shape. Such a variant of the invention is appropriate when installation space is very limited. The inventive concept in question nonetheless allows very reliable tensioning of the rail. The installation space may be limited to such an extent, for example as the result of specialized rail stems, that supporting a standard rail fastener would otherwise be impossible.

23917 PCT/EP2005/013211 **Transl. of WO 2006/061234**

List of Reference Numerals

1	Tensioning element
1a'	Torsion leg
1a"	Torsion leg
1b	Connecting section
1c'	End of torsion leg
1c"	End of torsion leg
1d'	Loop-shaped clamping section
1d"	Loop-shaped clamping section
1e'	End of clamping section
1e"	End of clamping section
1f'	Straight section
1f"	Straight section
1g'	Cutout
1g"	Cutout
1h'	First contact surface
1h"	First contact surface
1i'	Lateral region
1i"	Lateral region
1k'	Second contact surface
1k"	Second contact surface
2	Sleeper
3	Retaining plate
4	Fastening anchor
5	Rail foot
6	Rail
7	Plane of symmetry
8	Longitudinal axis
9	First plane
10	Second plane
11	Axis
12	Sleeper screw
13	Lower face of fastening anchor
14'	Lateral end region
14"	Lateral end region
15'	Contact surface
15"	Contact surface
16'	Lateral end region
16"	Lateral end region
17'	First channeled locking depression
17"	First channeled locking depression
18'	Second channeled locking depression
18"	Second channeled locking depression
19'	Channeled contact surface
19"	Channeled contact surface
20'	Curved depression
20"	Curved depression
21'	Contact surface
21"	Contact surface
22	Lower face of retaining plate
23	Projection
24	Recess in sleeper
25	Recess
26	Hook screw
27	Concrete sleeper anchor
28	Rail-bed plate
29	Slide chair plate
30	Rail bar
31	Rail stem
α	Angle
s_1	First distance
s_2	Second distance

Claims

1. A friction-fit elastic rail fastener for track systems, comprising a tensioning element (1) made of an elastic material, in particular hardened spring steel, that in the assembled state is fixed in place between a retaining plate (3) provided on a sleeper (2) and a fastening anchor (4) such that the tensioning element exerts a retention force on the foot (5) of a rail (6) in order to hold the rail (6) in position, the tensioning element (1) being symmetrically aligned with respect to a vertical plane of symmetry (7) that is perpendicular to the longitudinal axis (8) of the rail (6),

characterized in that

the tensioning element (1) has two torsion legs (1a' and 1a") that in the assembled state are at least substantially engaged between the retaining plate (3) and the fastening anchor (4), the two torsion legs (1a' and 1a") being connected to one another on the side facing away from the rail (6) by means of a connecting section (1b),

and a loop-shaped clamping section (1d' and 1d") is provided on each end (1c' and 1c") of the torsion leg (1a' and 1a") facing the rail (6), and adjacent the torsion legs (1a' and 1a") the clamping section first extends essentially perpendicularly to the plane (7), and then extends in a looped manner until the ends (1e' and 1e") of the clamping section (1d' and 1d") reach the vicinity of the ends (1c' and 1c") of the torsion legs (1a' and 1a"), where they form a support surface on the rail foot (5),

in the non-tensioned state of the tensioning element (1) the torsion legs (1a' and 1a") together with the connecting section (1b) lying essentially in a first plane (9), and at least a portion of the loop-shaped clamping sections (1d' and 1d") lying in a second plane (10), whereby the second plane (10) is rotated about an axis (11) in relation to the first plane (9), the axis extending parallel to the sectional axis of the plane of symmetry (7) containing the first plane (9).

2. The rail fastener according to claim 1,
characterized in that
in the assembled state of the tensioning element (1) the second plane (10) is substantially congruent with the first plane (9).

3. The rail fastener according to claim 1 or 2,
characterized in that
the two torsion legs (1a' and 1a") of the tensioning element (1) are essentially parallel.

4. The rail fastener according to one of claims 1 through 3,
characterized in that
the loop-shaped clamping sections (1d' and 1d") in the assembled state of the tensioning element (1) and under normal load on the rail (6) contact the rail foot (5) only at the ends (1e' and 1e") of the clamping sections (1d' and 1d").

5. The rail fastener according to one of claims 1 through 3,

characterized in that

the ends (1e' and 1e") of the clamping sections (1d' and 1d") in the assembled state engage with recesses (25) provided for same in the retaining plate (3).

6. The rail fastener according to claim 5,

characterized in that

the recesses (25) in the retaining plate (3) have locking projections.

7. The rail fastener according to one of claims 1 through 6,

characterized in that

the loop-shaped clamping sections (1d' and 1d") first extend from the ends (1c' and 1c") of the torsion legs (1a' and 1a"), essentially perpendicular to the plane (7), and then extend in the direction away from the rail (6) in order to return back to the rail (6) in a curved progression.

8. The rail fastener according to claim 7,

characterized in that

the loop-shaped clamping sections (1d' and 1d") have an S-shaped curve, at least in places.

9. The rail fastener according to one of claims 1 through 8,

characterized in that

the loop-shaped clamping sections (1d' and 1d") as viewed from above have an essentially circular or oval shape or have a circular or oval section.

10. The rail fastener according to one of claims 1 through 9,

characterized in that

the loop-shaped clamping sections (1d' and 1d") adjacent the torsion legs (1a' and 1a") first extend essentially perpendicularly away from the plane of symmetry (7).

11. The rail fastener according to one of claims 1 through 10,

characterized in that

the angle (α) between the first plane (9) and the second plane (10) is between 5° and 30° in the non-tensioned state of the tensioning element (1).

12. The rail fastener according to one of claims 1 through 11,

characterized in that

the ends (1e', 1e") of the loop-shaped clamping sections (1d' and 1d") are designed as straight sections (1f' and 1f").

13. The rail fastener according to claim 12, characterized in that the straight sections (1f' and 1f") are parallel.

14. The rail fastener according to one of claims 1 through 13, characterized in that the ends (1e' and 1e") of the clamping sections (1d' and 1d"), in particular the straight sections (1f' and 1f"), have a cutout (1g' and 1g") that is designed as a support surface on the rail foot (5).

15. The rail fastener according to one of claims 1 through 14, characterized in that each clamping section (1d' and 1d") has a first contact surface (1h' and 1h") in the lateral region (1i' and 1i") of the clamping section (1d' and 1d") for contacting the rail foot (5), and during a first overload case for the forces acting on the rail (6) the first contact surface contacts the rail foot (5).

16. The rail fastener according to claim 15, characterized in that each clamping section (1d' and 1d") has a second contact surface (1k' and 1k") for contacting the fastening anchor (4), and during a second, more intense overload case that exceeds the first

overload case for the forces acting on the rail (6) the second contact surface contacts the fastening anchor (4).

17. The rail fastener according to one of claims 1 through 16,
characterized in that
the retaining plate (3) is integrated into a rail-bed plate (28).

18. The rail fastener according to one of claims 1 through 17,
characterized in that
the retaining plate (3) and the fastening anchor (4) have a two-piece design.

19. The rail fastener according to claim 18,
characterized in that
the retaining plate (3) and the fastening anchor (4) are connected or held together by means of a hook screw (26).

20. The rail fastener according to claim 19,
characterized in that
the fastening anchor (4) has a plate-shaped design and is fixed in place by a sleeper screw (12).

21. The rail fastener according to one of claims 1 through 17,

characterized in that

the retaining plate (3) and the fastening anchor (4) have a one-piece design.

22. The rail fastener according to one of claims 1 through 21,

characterized in that

on its lower face (13) the fastening anchor (4) in its lateral end regions (14' and 14") facing the rail (6) has contact surfaces (15' and 15") for the loop-shaped clamping sections (1d' and 1d").

23. The rail fastener according to one of claims 1 through 22,

characterized in that

on its lower face (13) the fastening anchor (4) in its lateral end regions (16' and 16") facing away from the rail (6) has a first channeled locking depression (17' and 17") in each case for locking the tensioning element (1) in a preassembled position.

24. The rail fastener according to one of claims 1 through 23,

characterized in that

on its lower face (13) the fastening anchor (4) in its lateral end regions (16' and 16") facing away from the rail (6) has second channeled locking depressions (18' and 18") in each case for locking the tensioning element (1) in a neutral position.

25. The rail fastener according to one of claims 1 through 24,

characterized in that

on its lower face (13) the fastening anchor (4) has two channeled contact surfaces (19' and 19") for contacting the torsion legs (1a' and 1a") of the tensioning element (1) in the final assembled state.

26. The rail fastener according to one of claims 1 through 20 or 22 through 25,

characterized in that

the fastening anchor (4) is formed by the sleeper screw (12) or by a washer connected thereto.

27. The rail fastener according to one of claims 1 through 26,

characterized in that

the retaining plate (3) has two curved depressions (20' and 20"), extending perpendicular to the longitudinal axis (8) of the rail (6), for guiding the tensioning element (1) during installation thereof.

28. The rail fastener according to one of claims 1 through 27,

characterized in that

the retaining plate (3) has two contact surfaces (21' and 21") for contacting the tensioning element (1) in its assembled state.

29. The rail fastener according to one of claims 1 through 28,

characterized in that

on its lower face (22) the retaining plate (3) has a projection (23), extending in the direction of the longitudinal axis (8) of the rail (6), for engaging with a corresponding recess (24) in the sleeper (2).

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Fig. 1

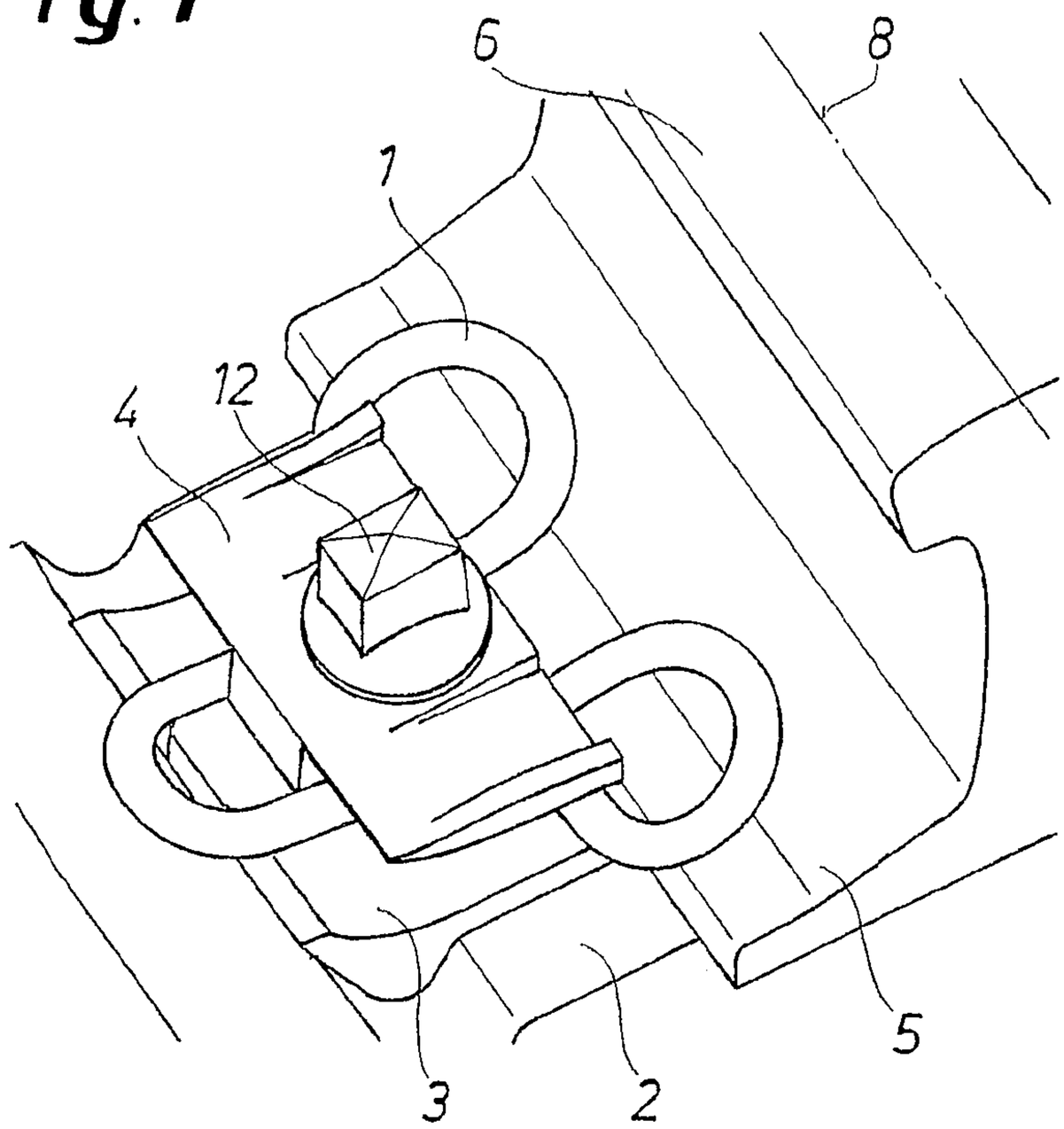


Fig. 2

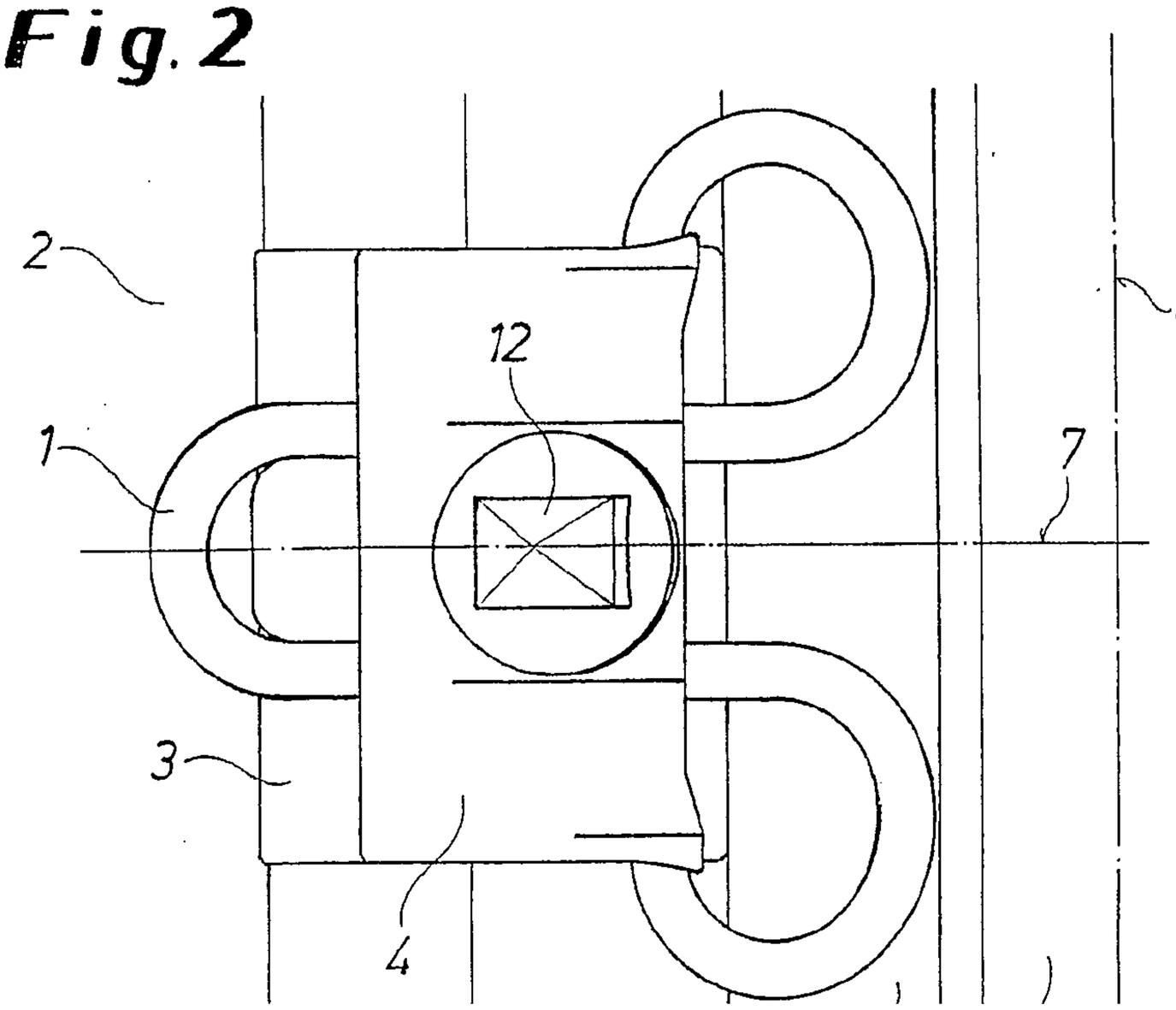


Fig. 3

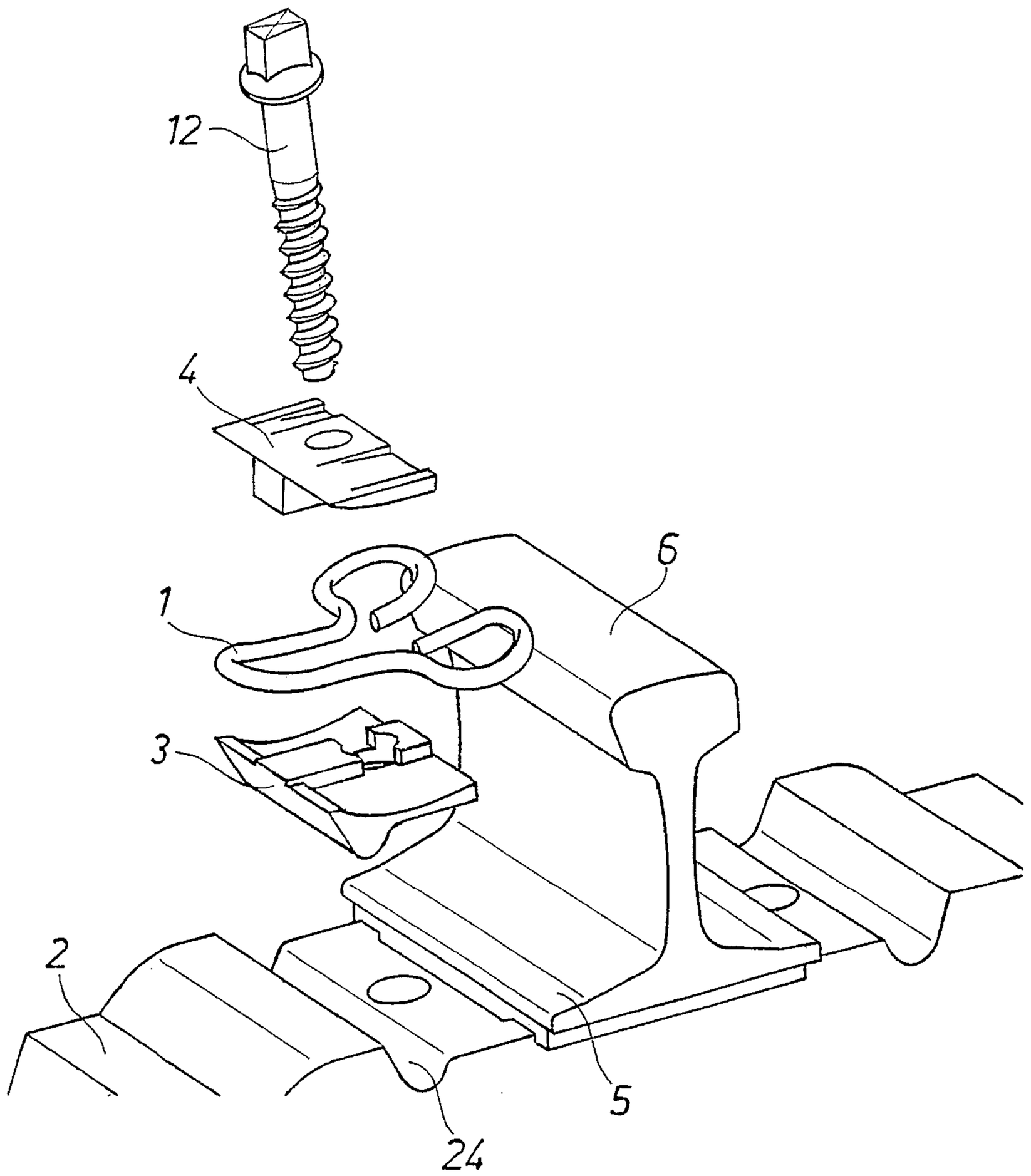


Fig. 4

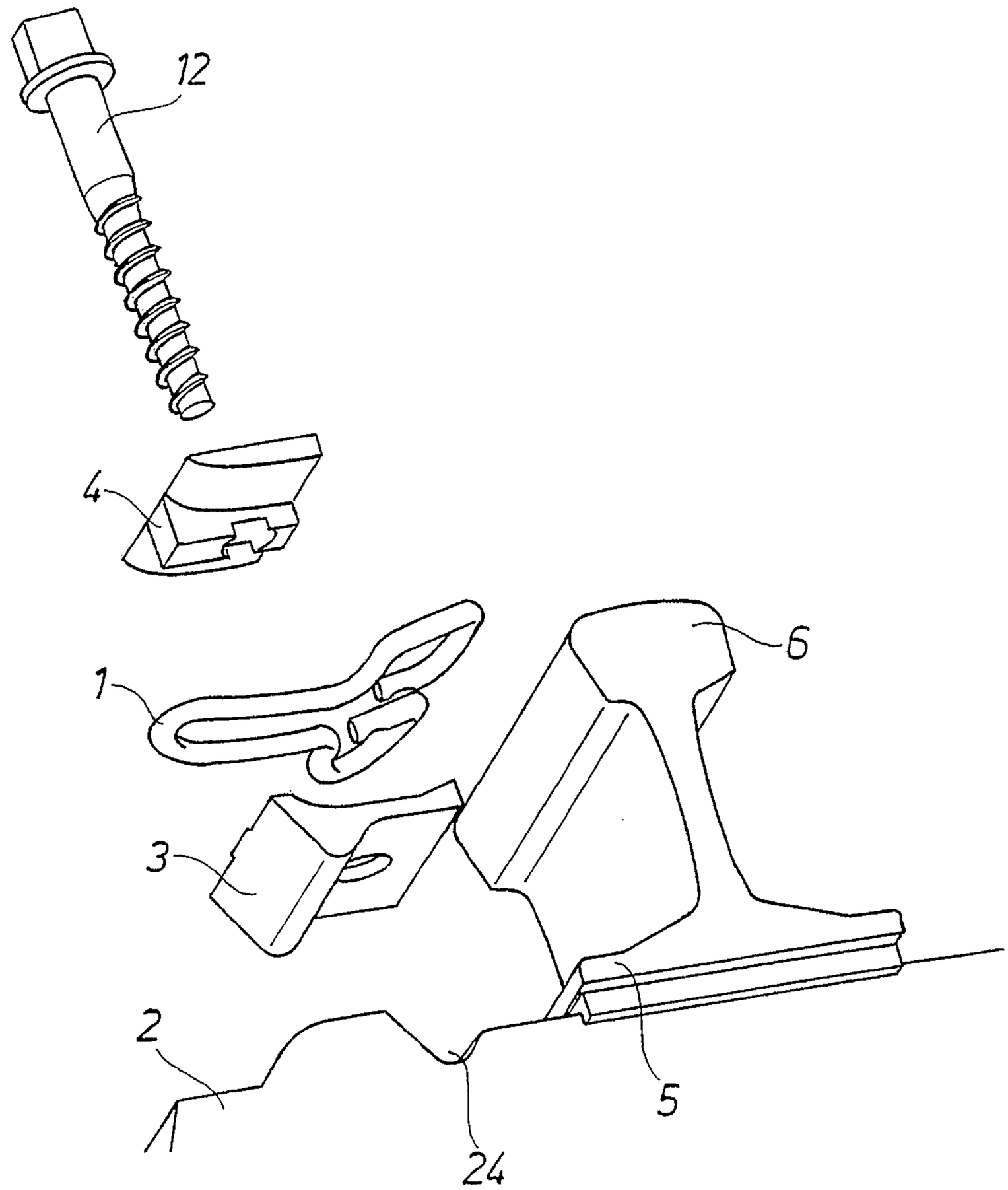


Fig. 5

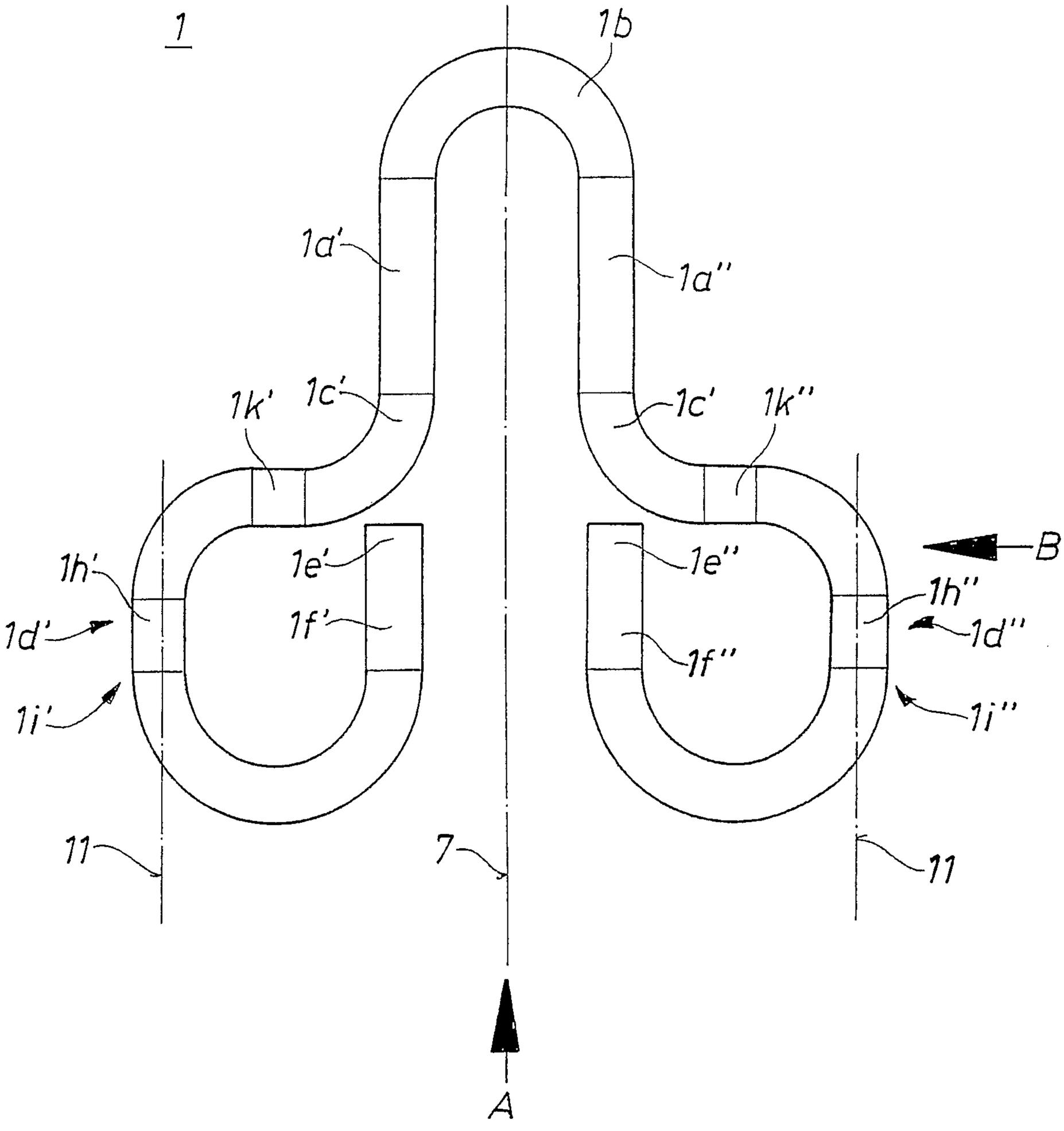

1
1b
1a'
1a''
1k'
1c'
1c'
1k''
1h'
1e'
1e''
B
1h''
1d'
1f'
1f''
1d''
1i'
1i''
11
7
11
A

Fig. 6

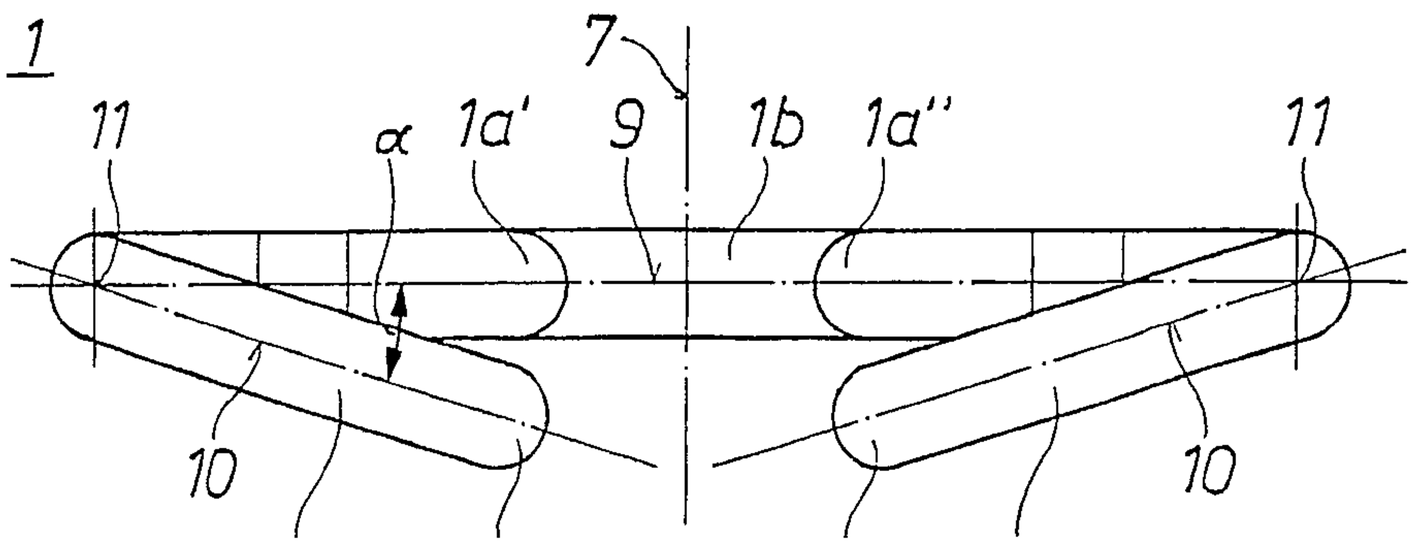

1
7
11
α
1a'
9
1b
1a''
11
10
10

Fig.7

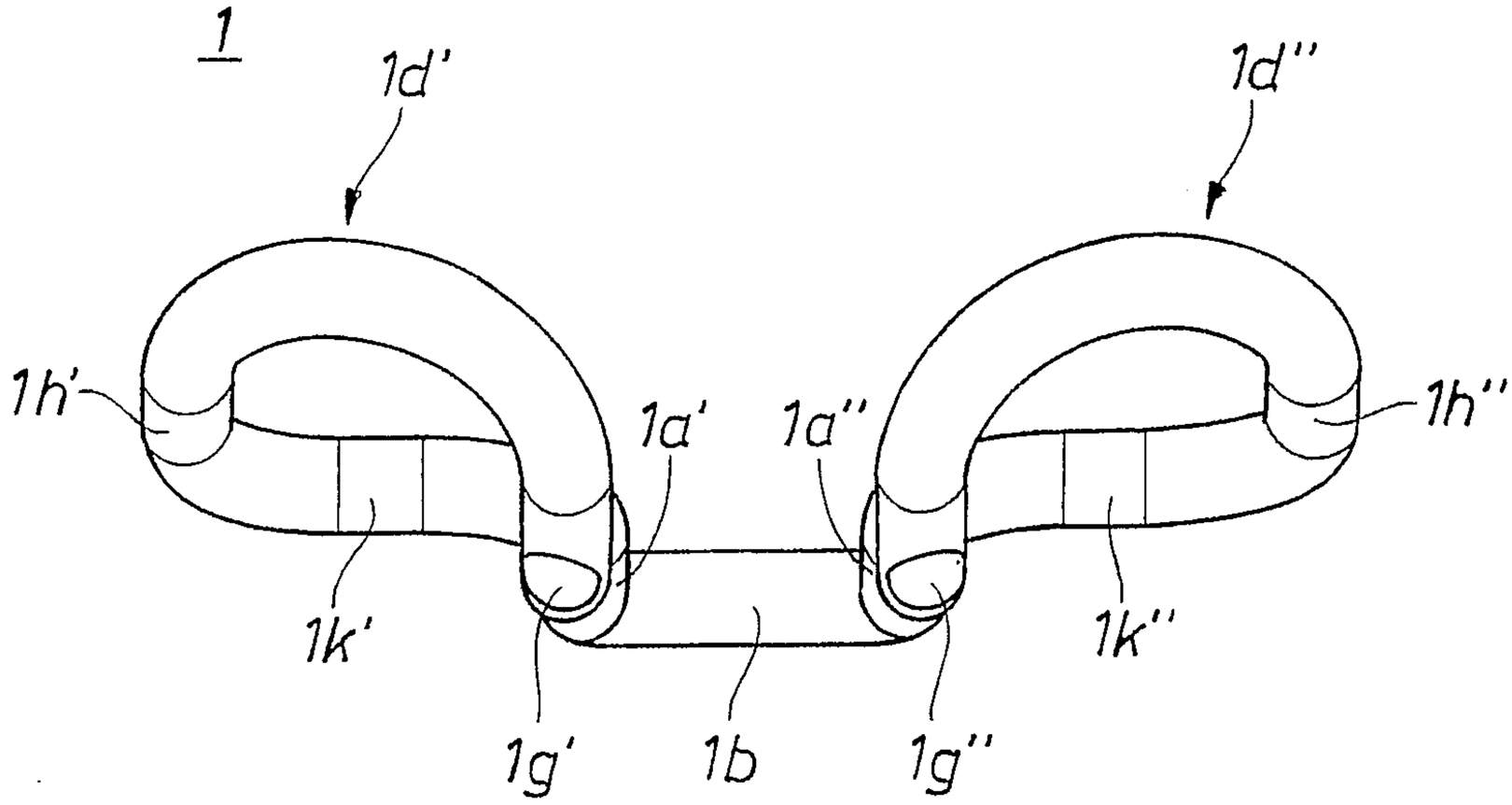


Fig.8

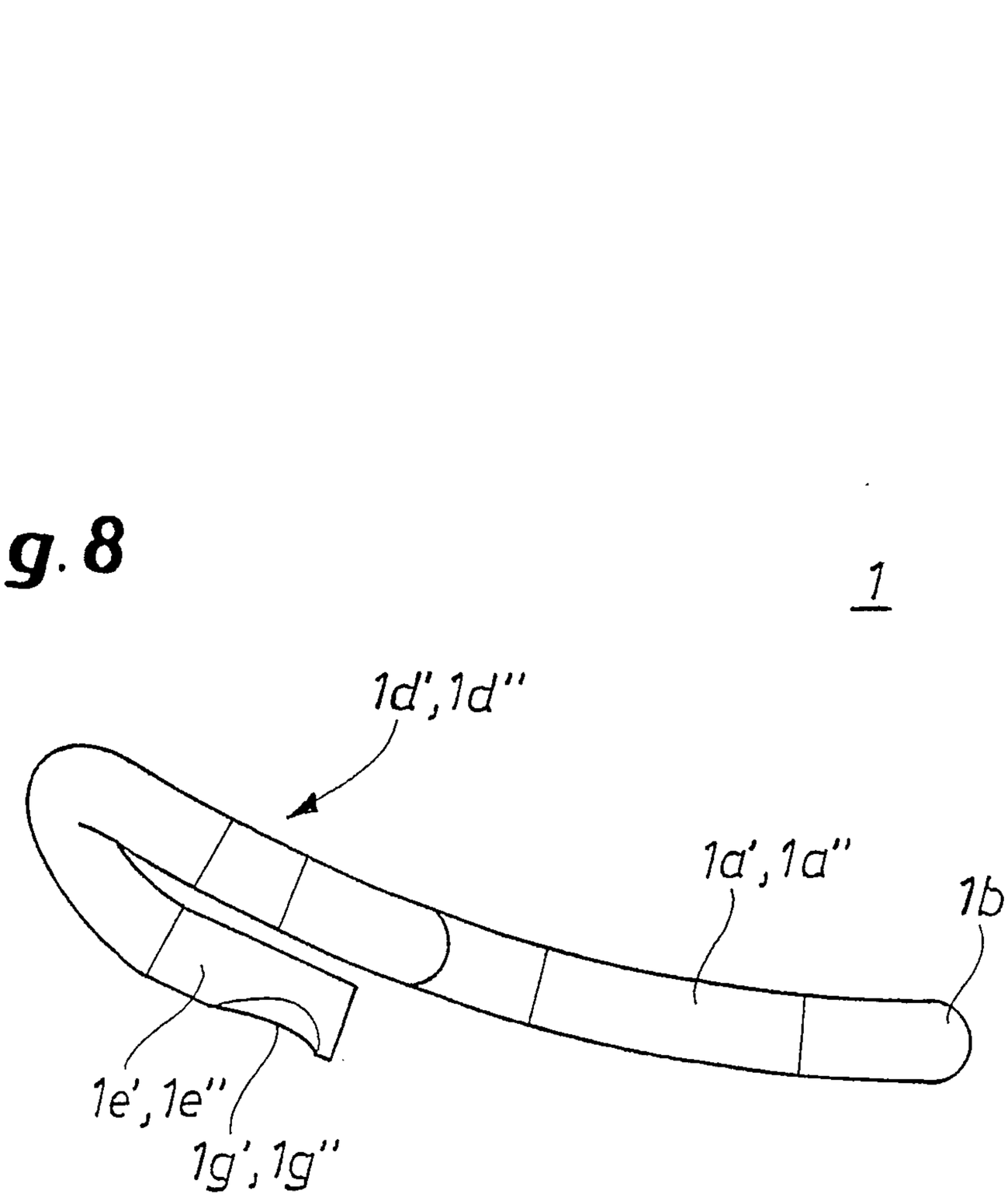


Fig. 9

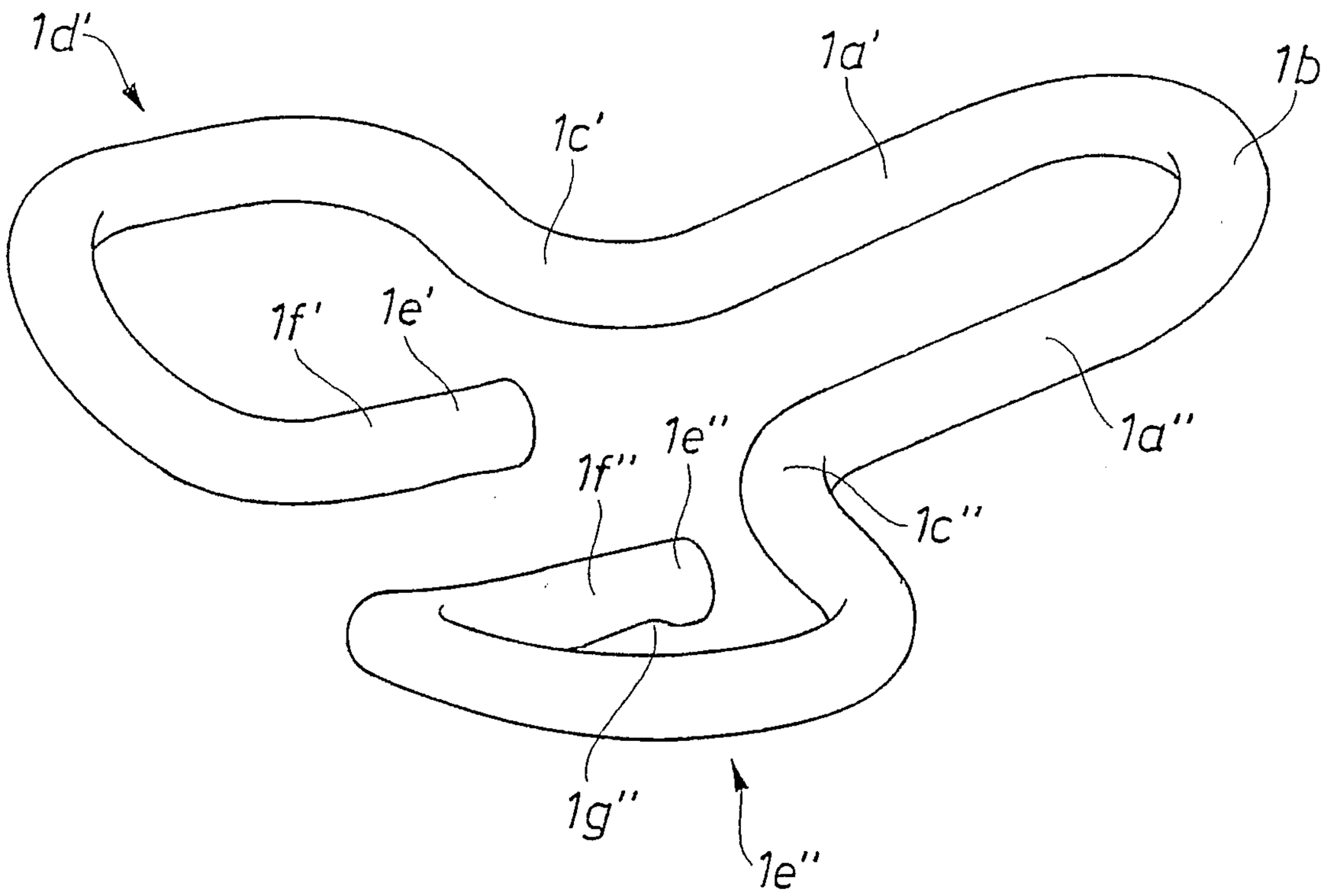


Fig. 10

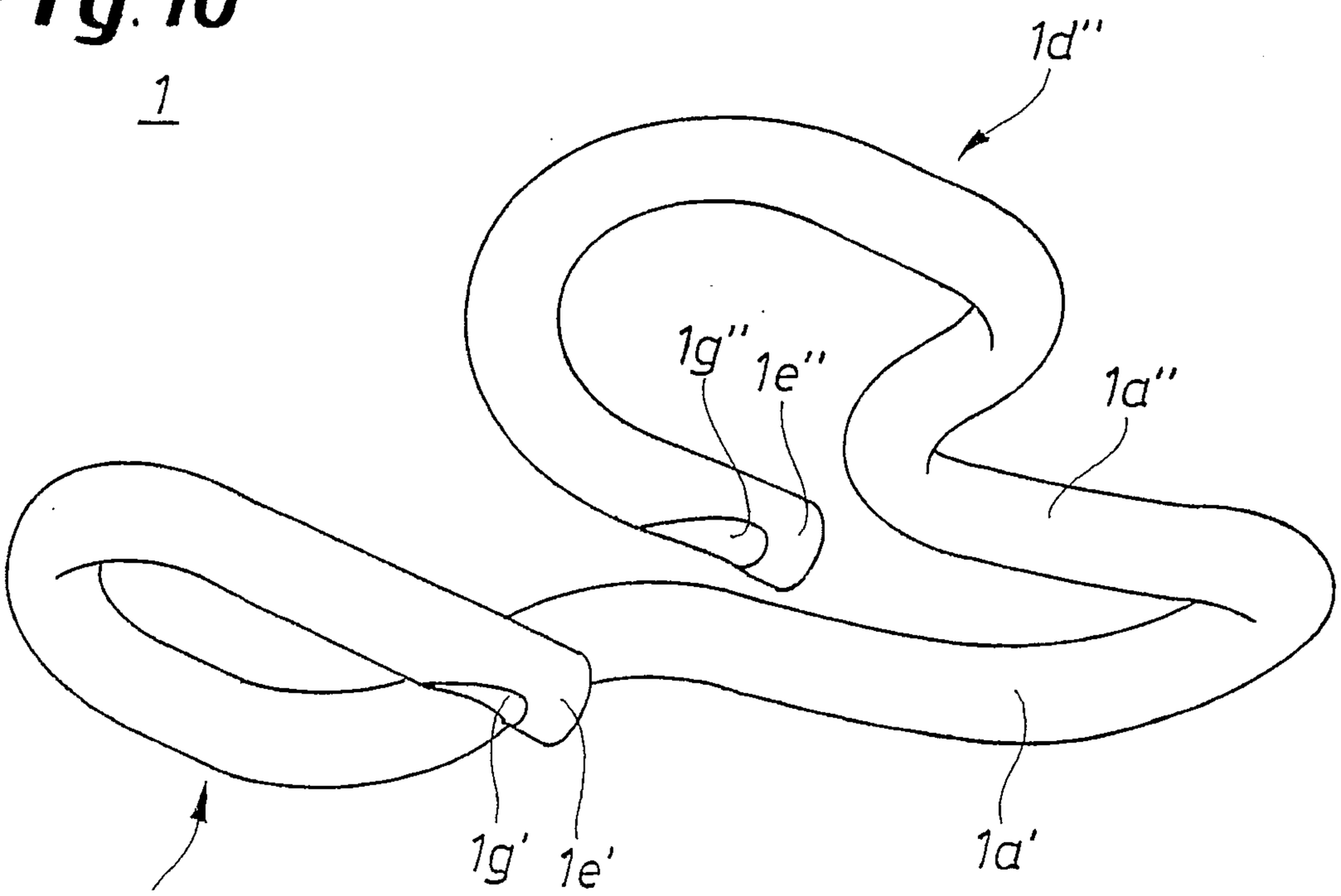


Fig. 11

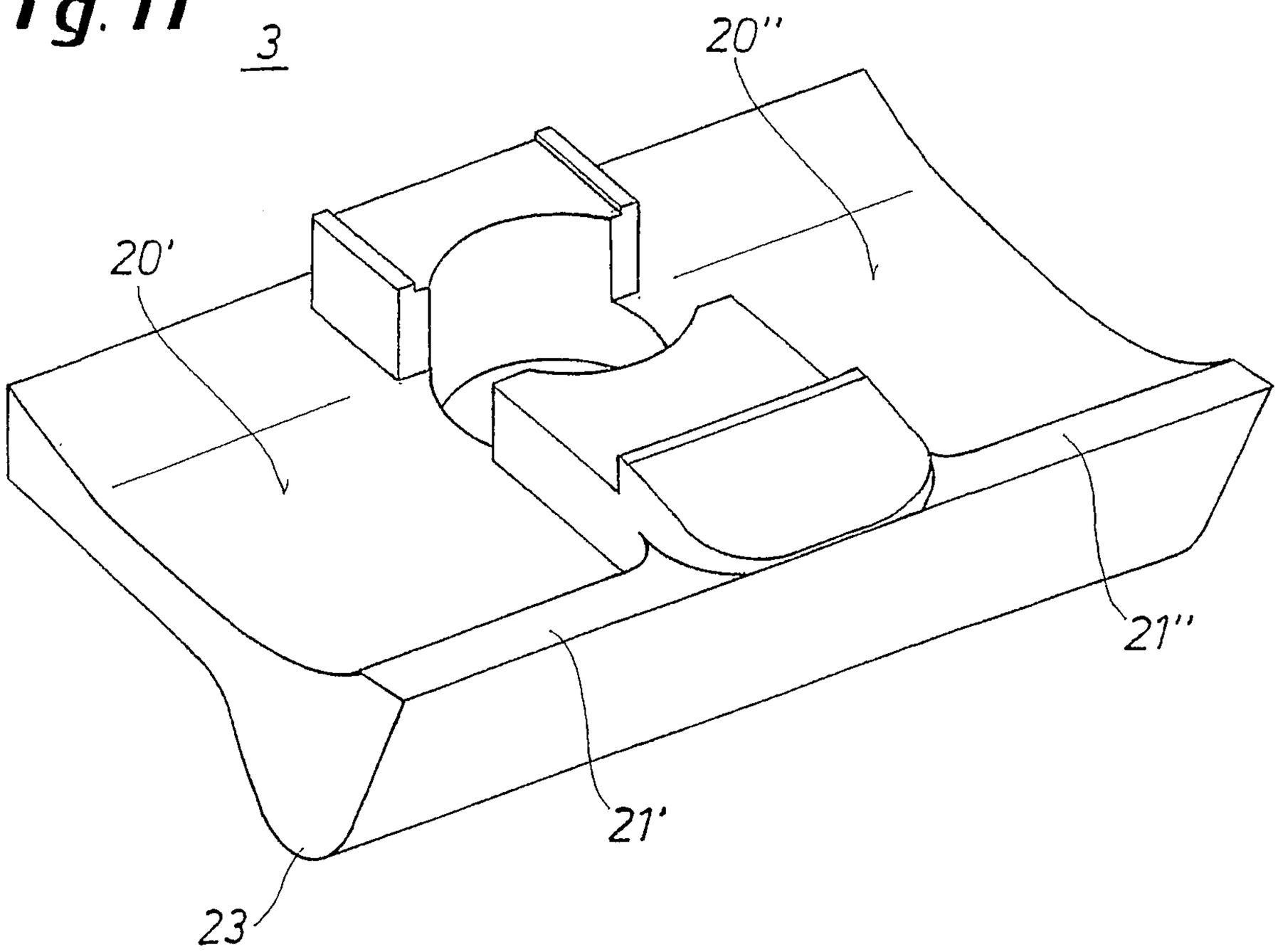


Fig. 12

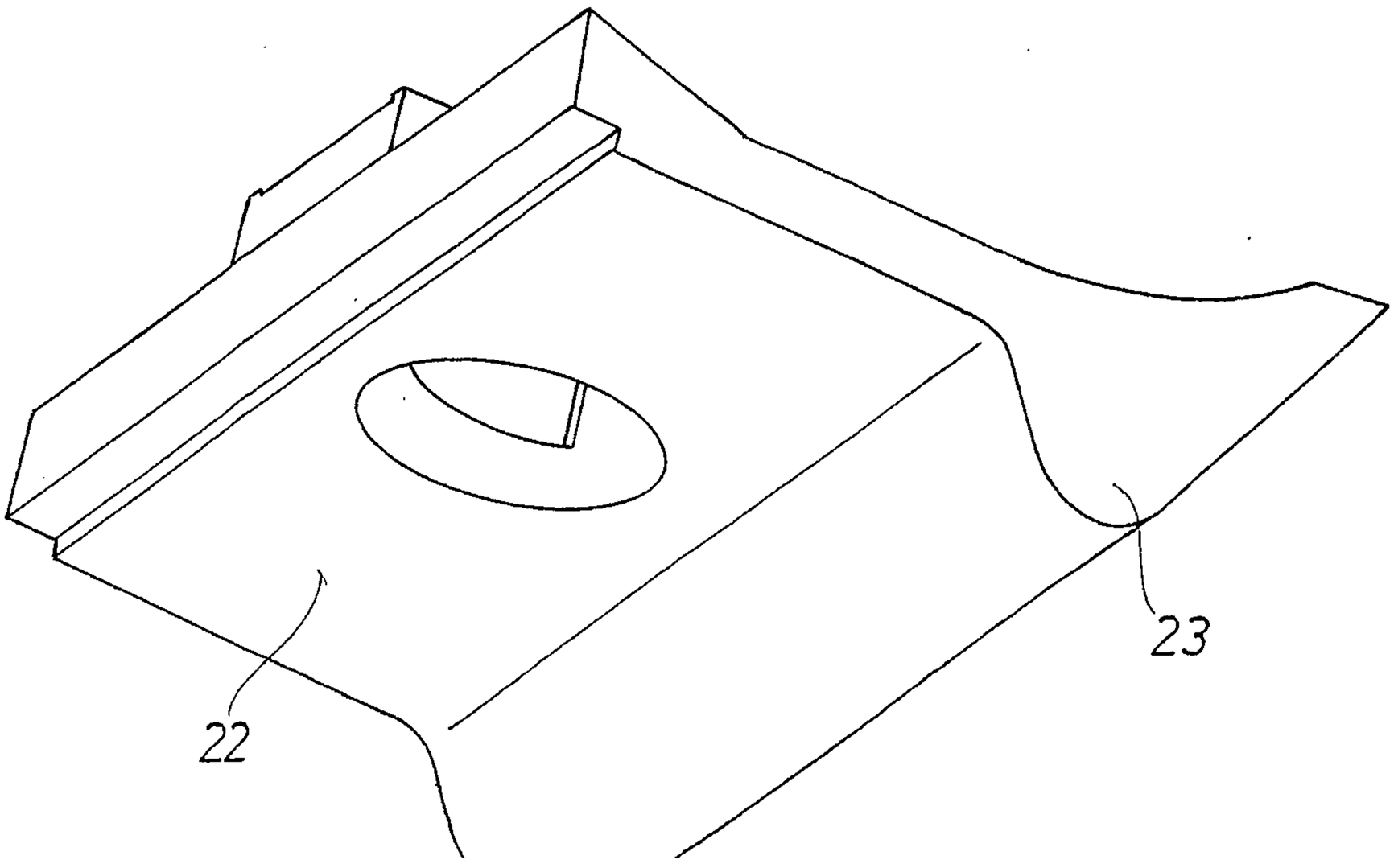


Fig. 13

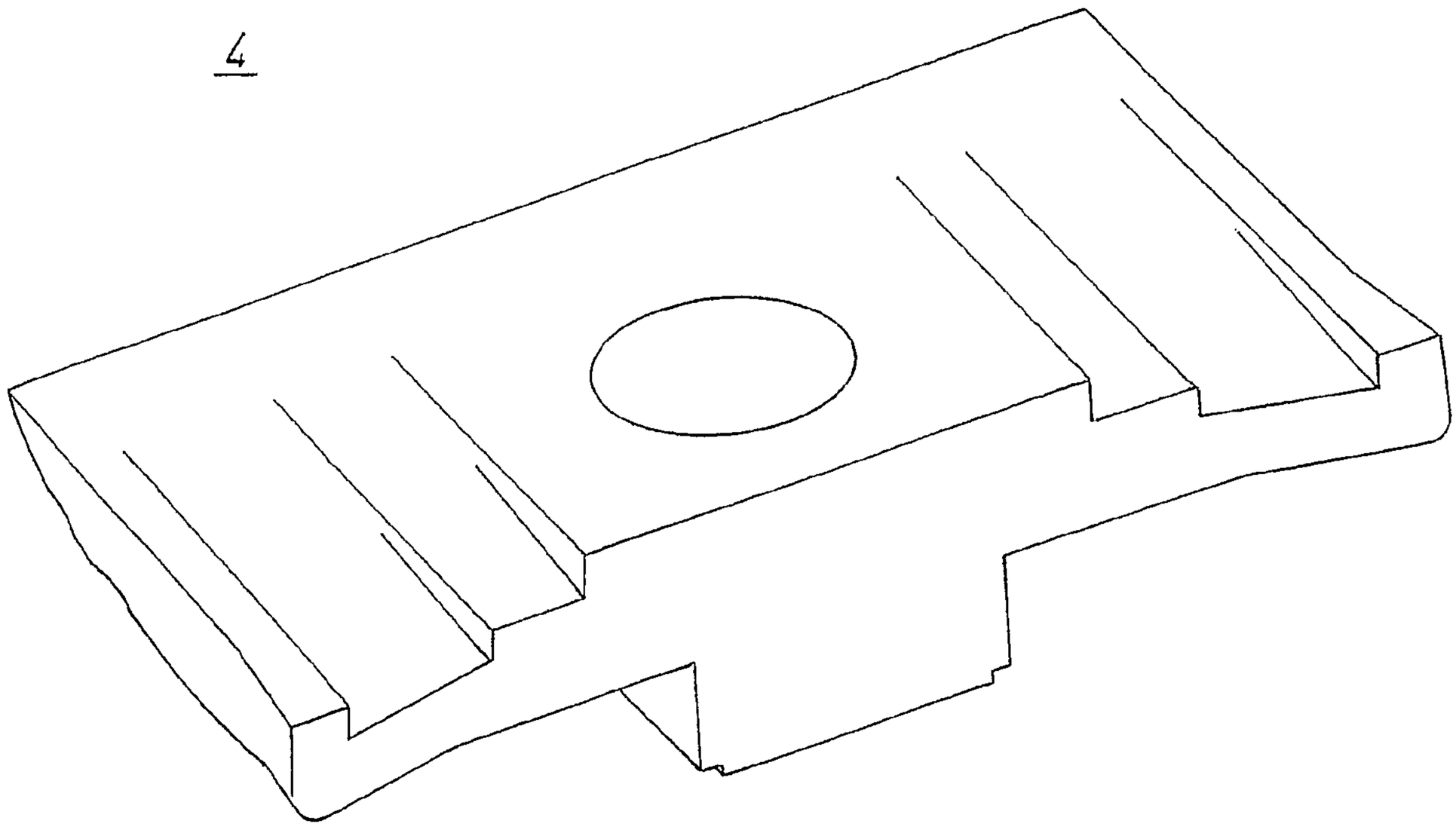


Fig. 14

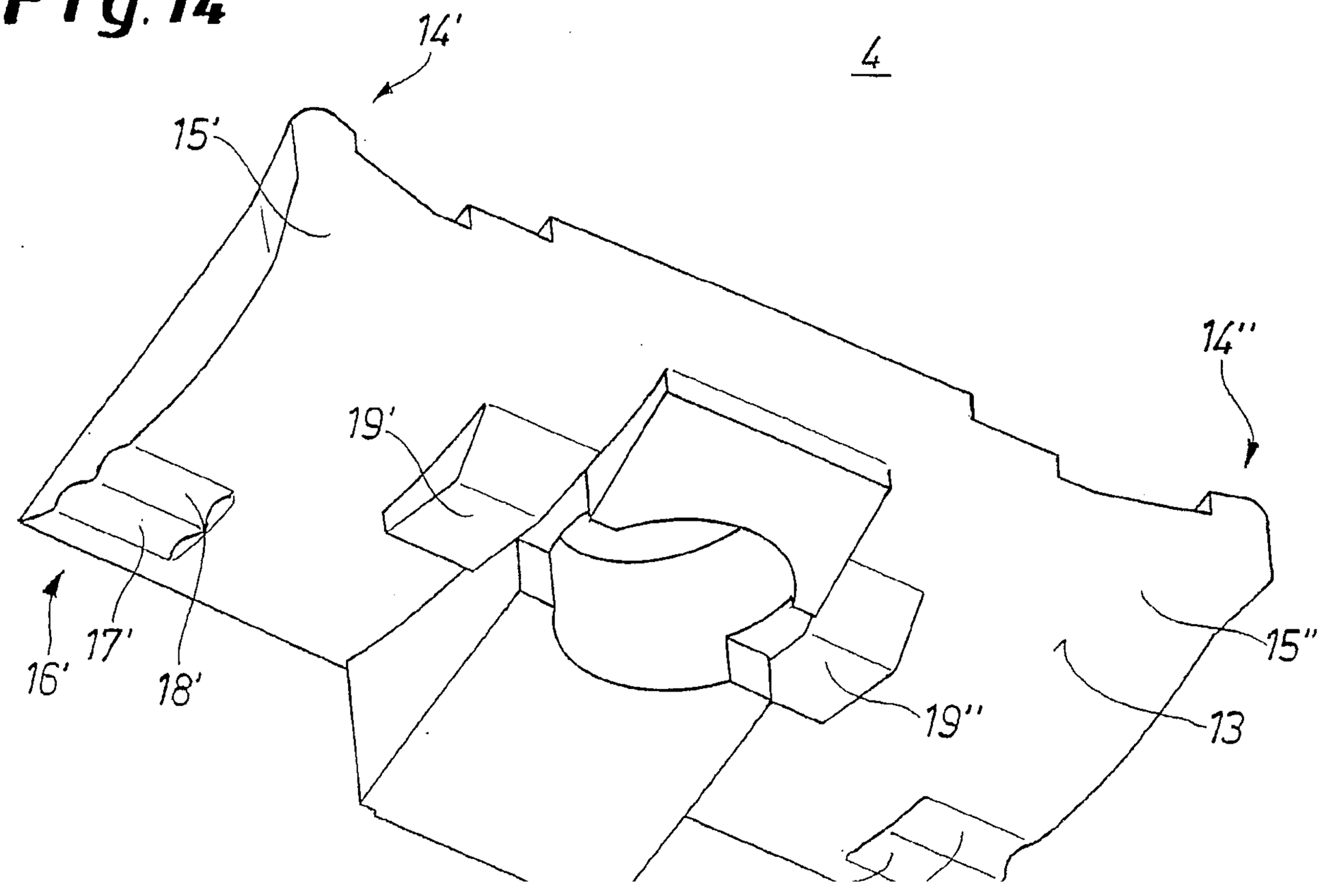


Fig. 15

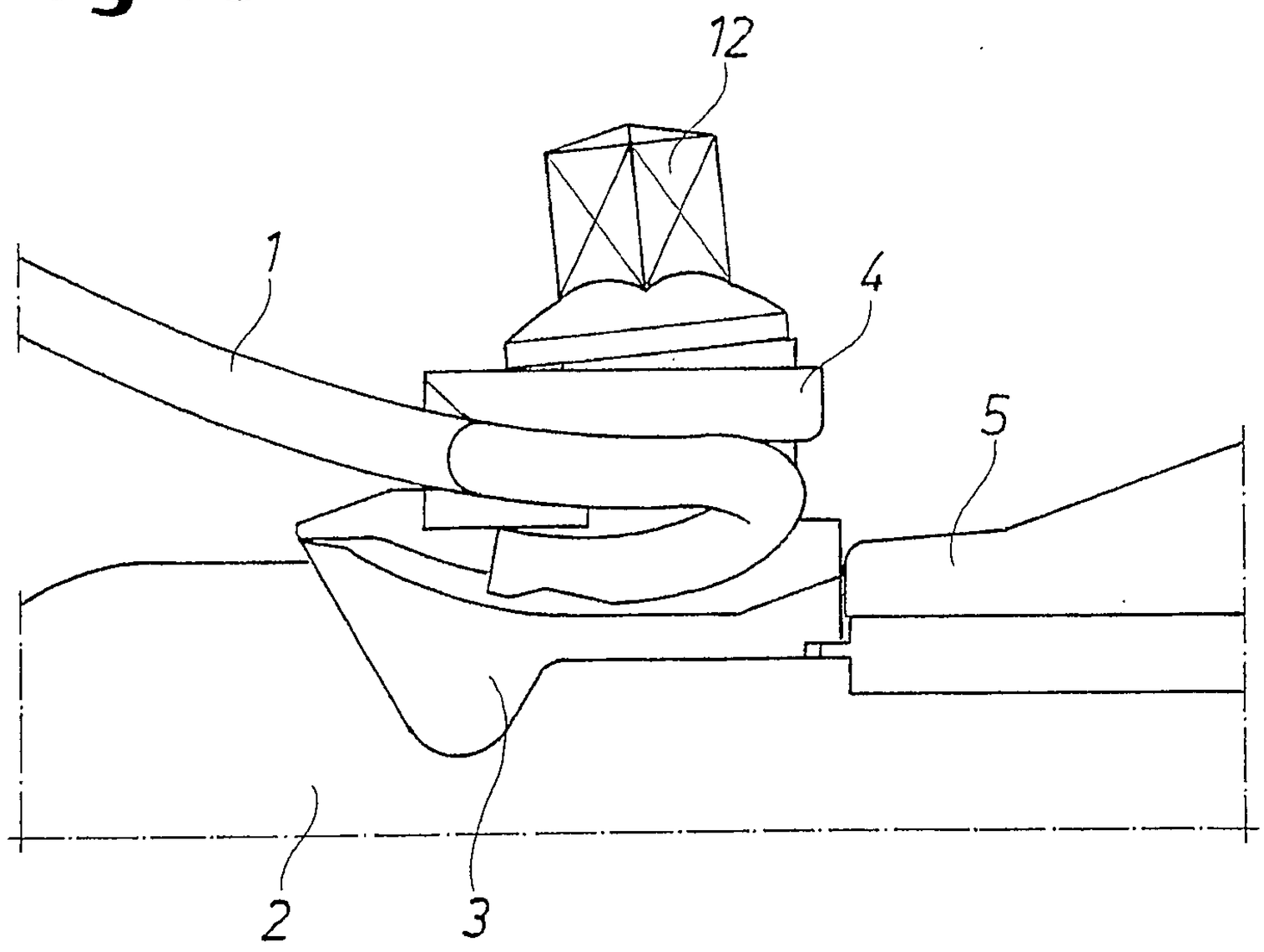


Fig. 16

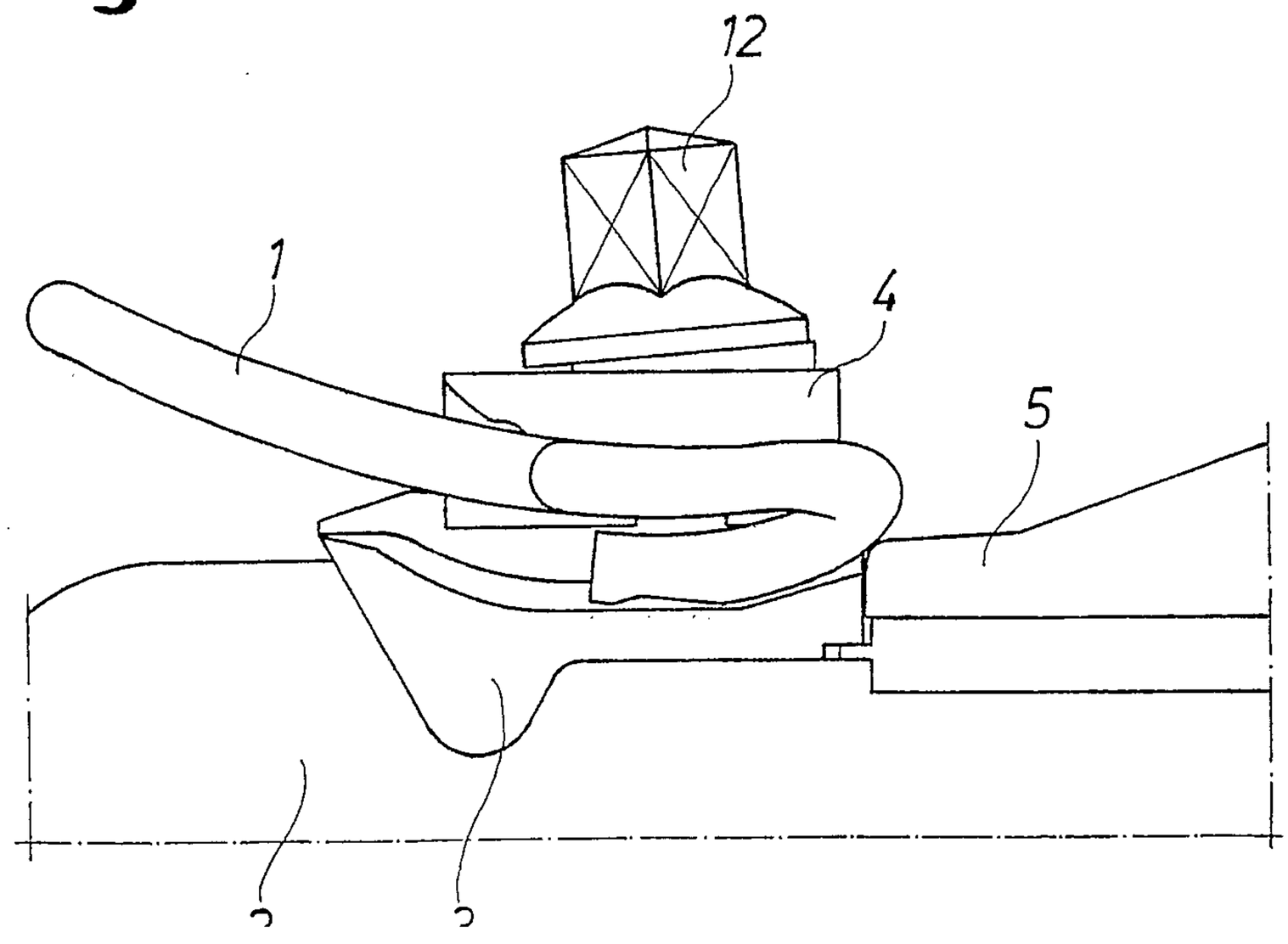


Fig. 17

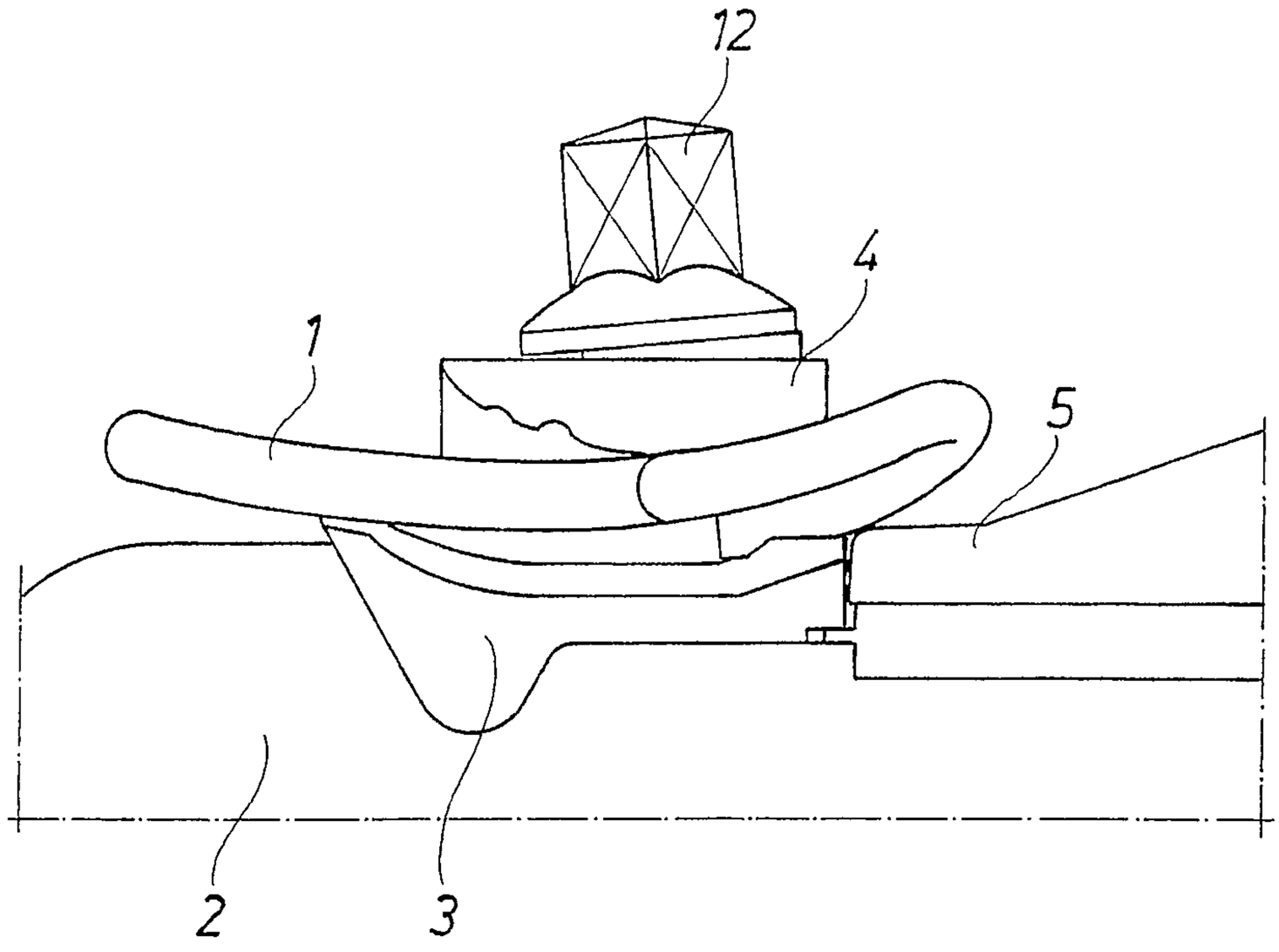


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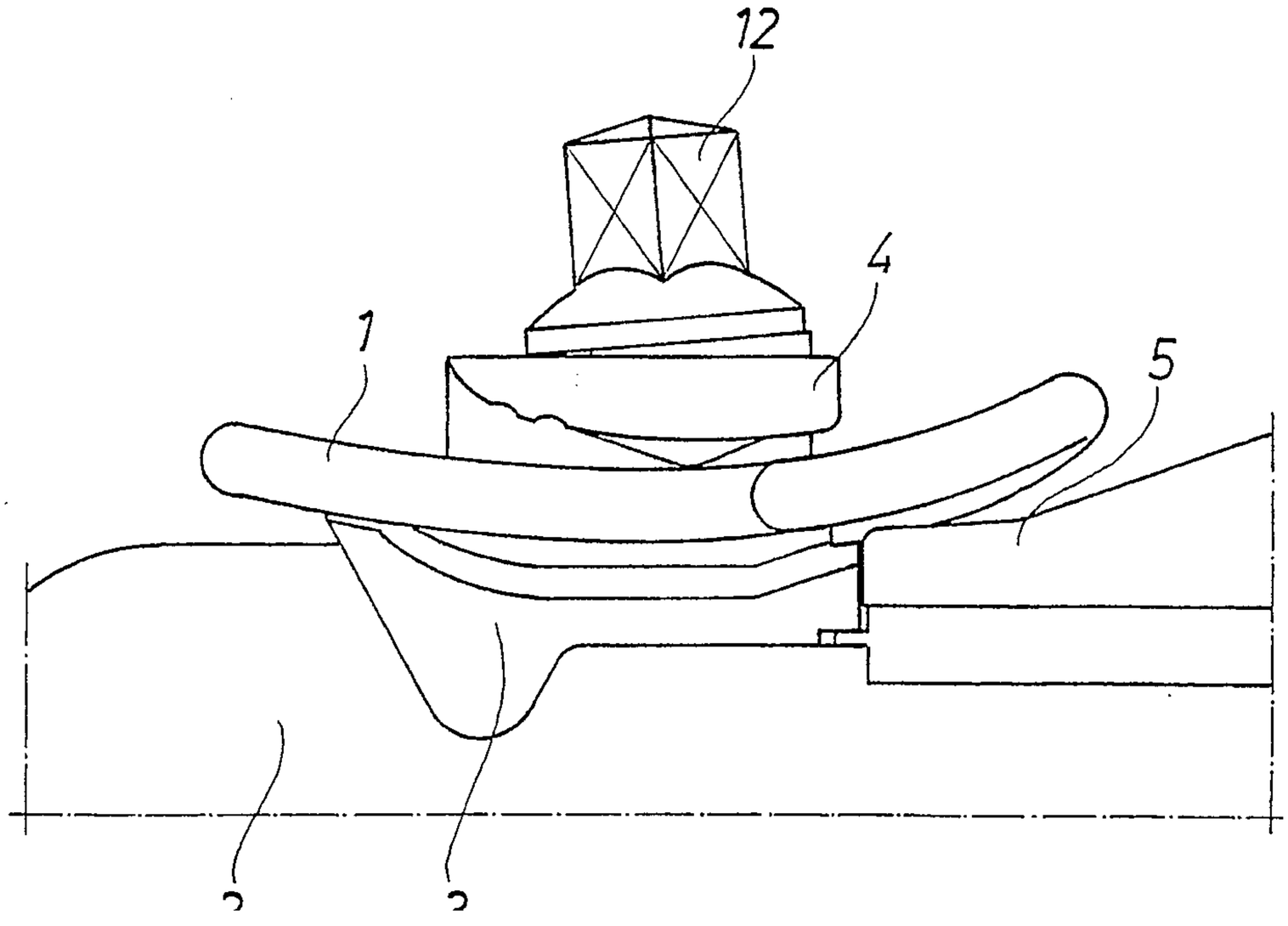


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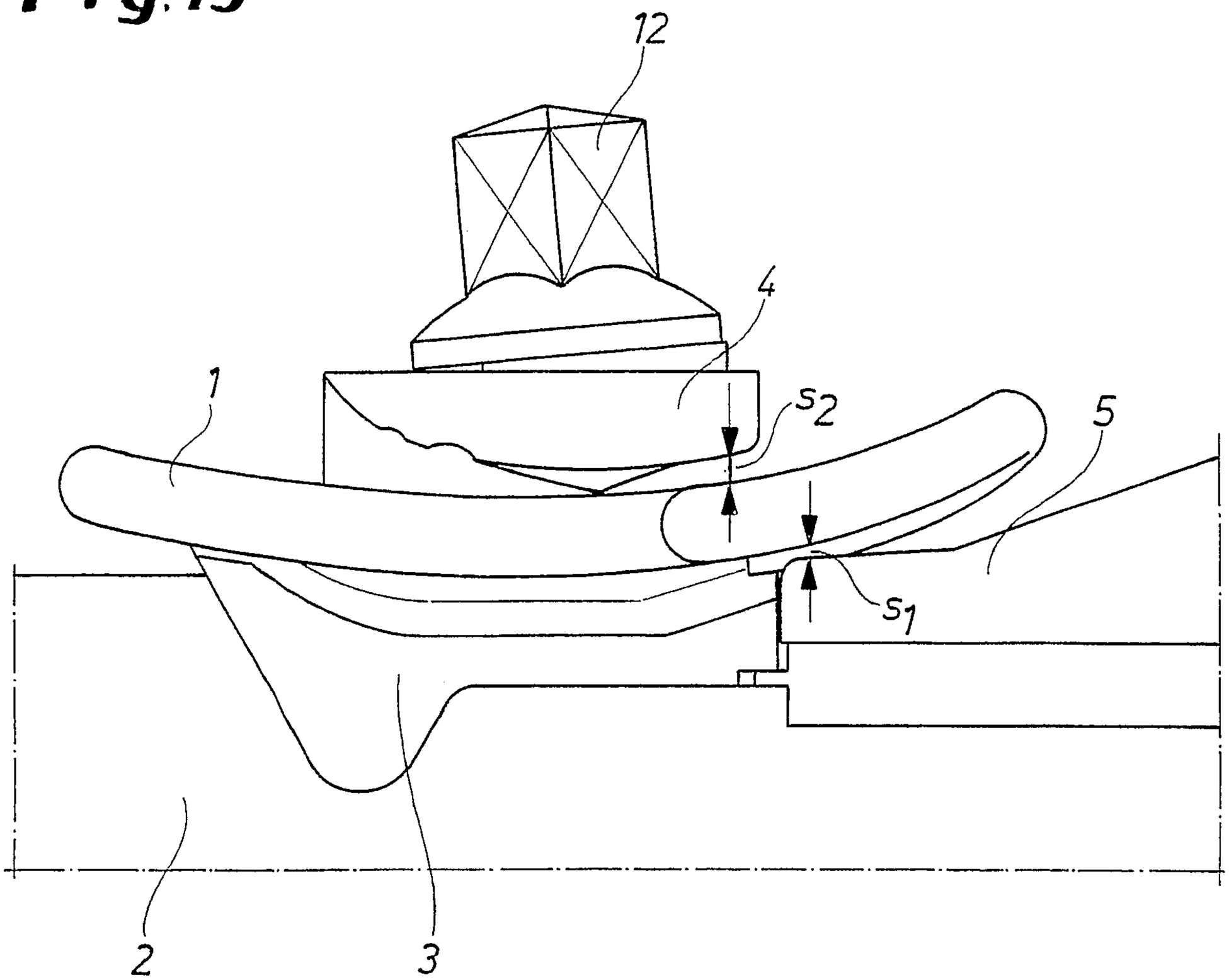


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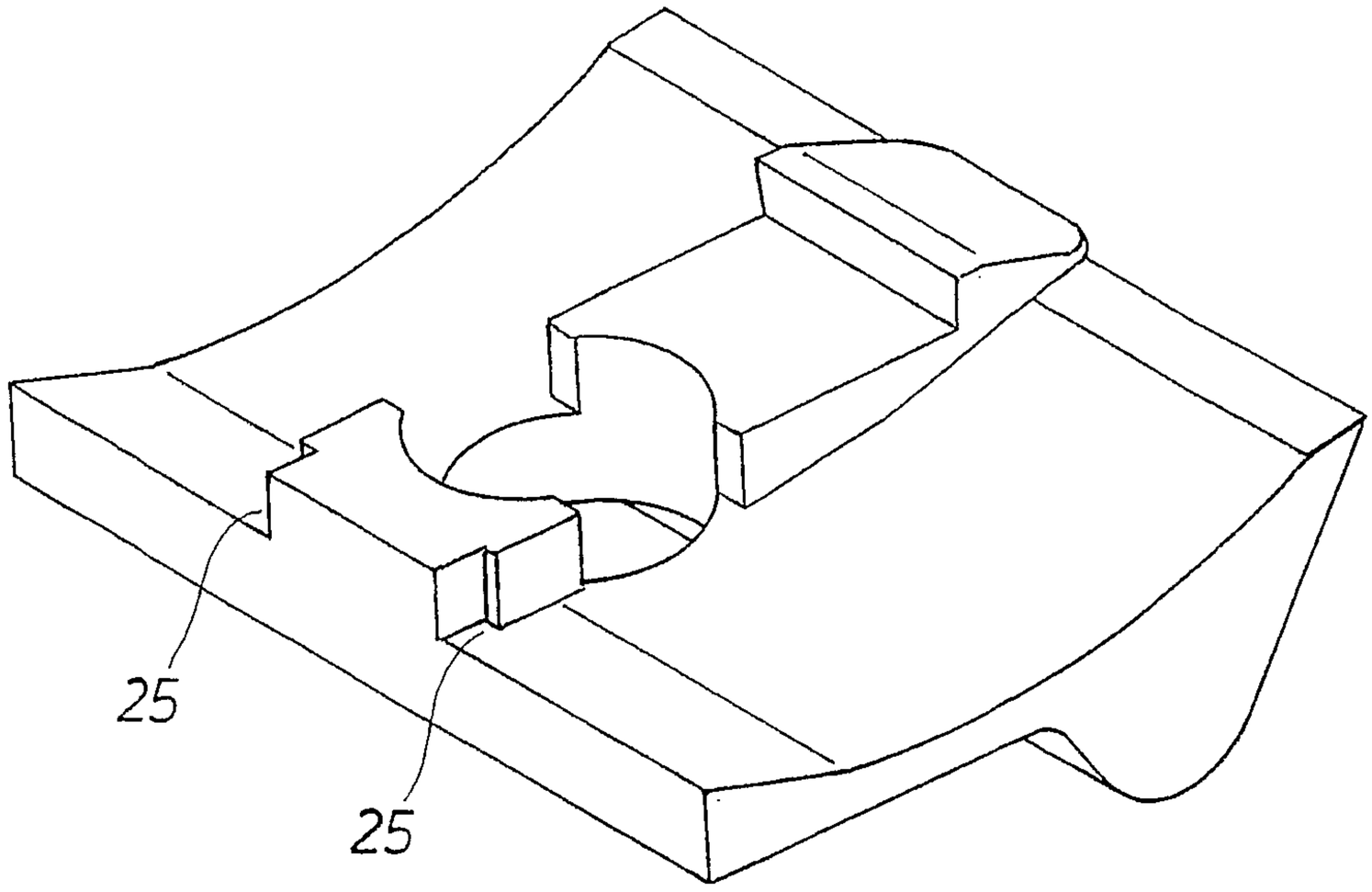


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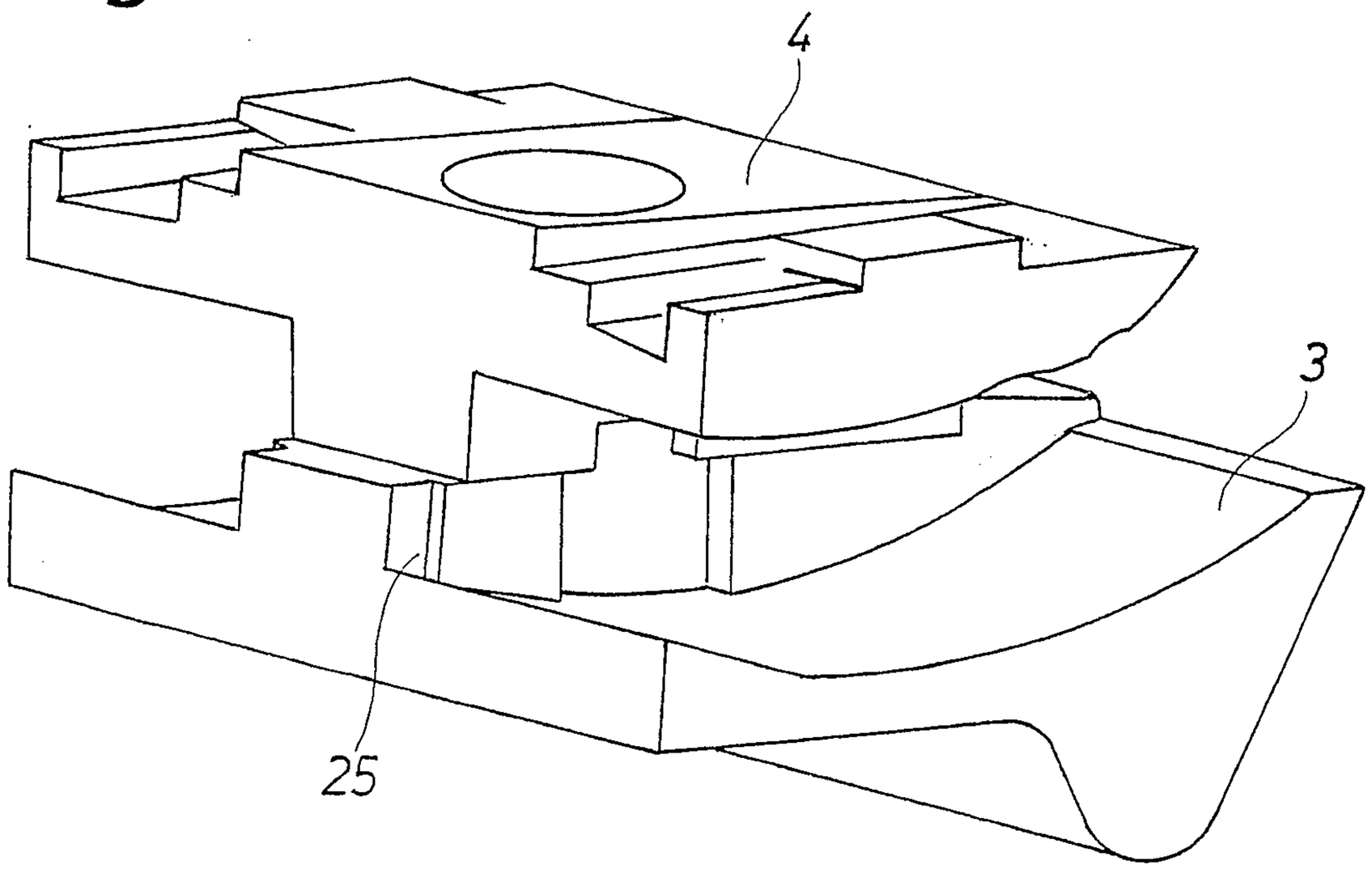


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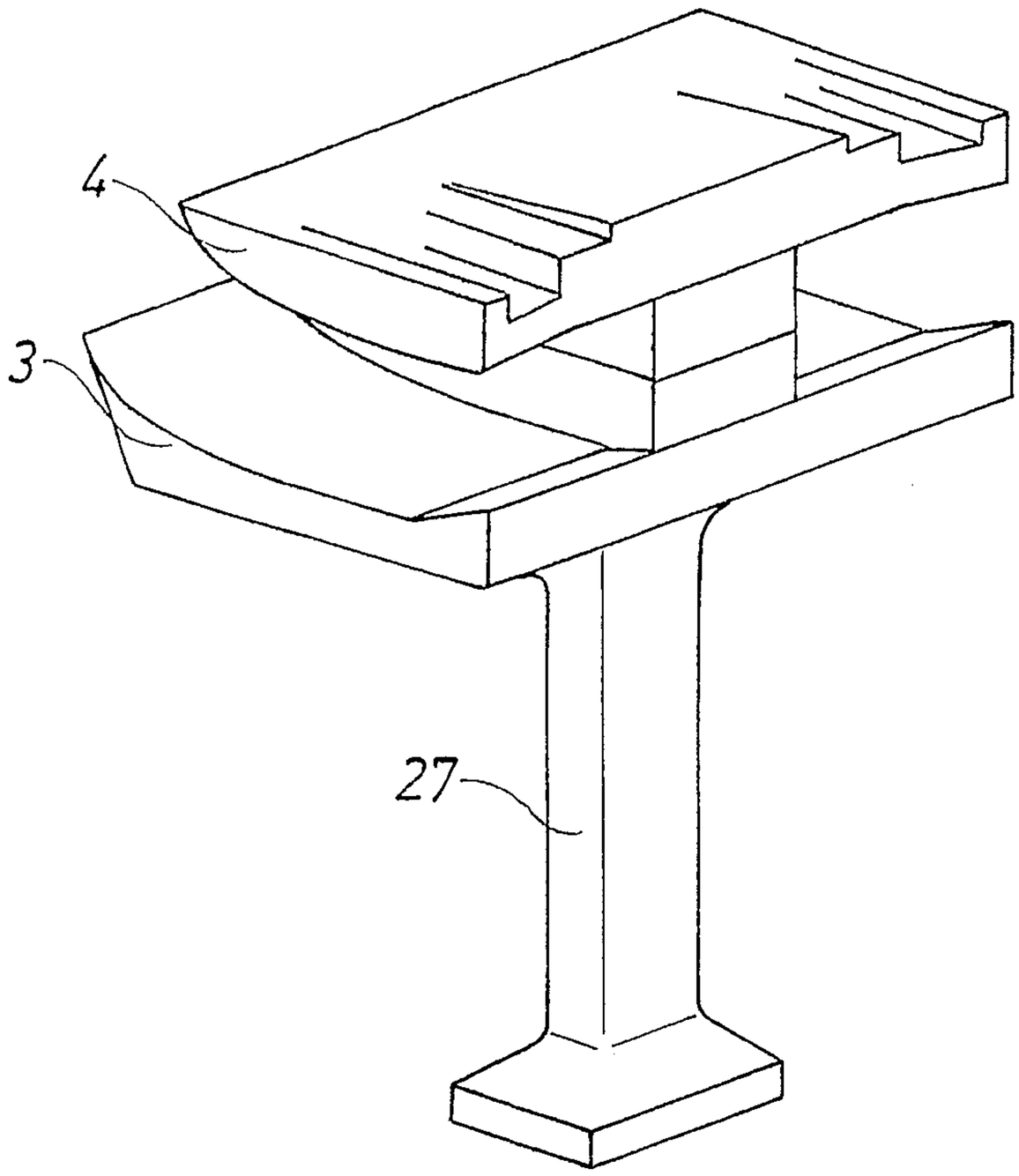


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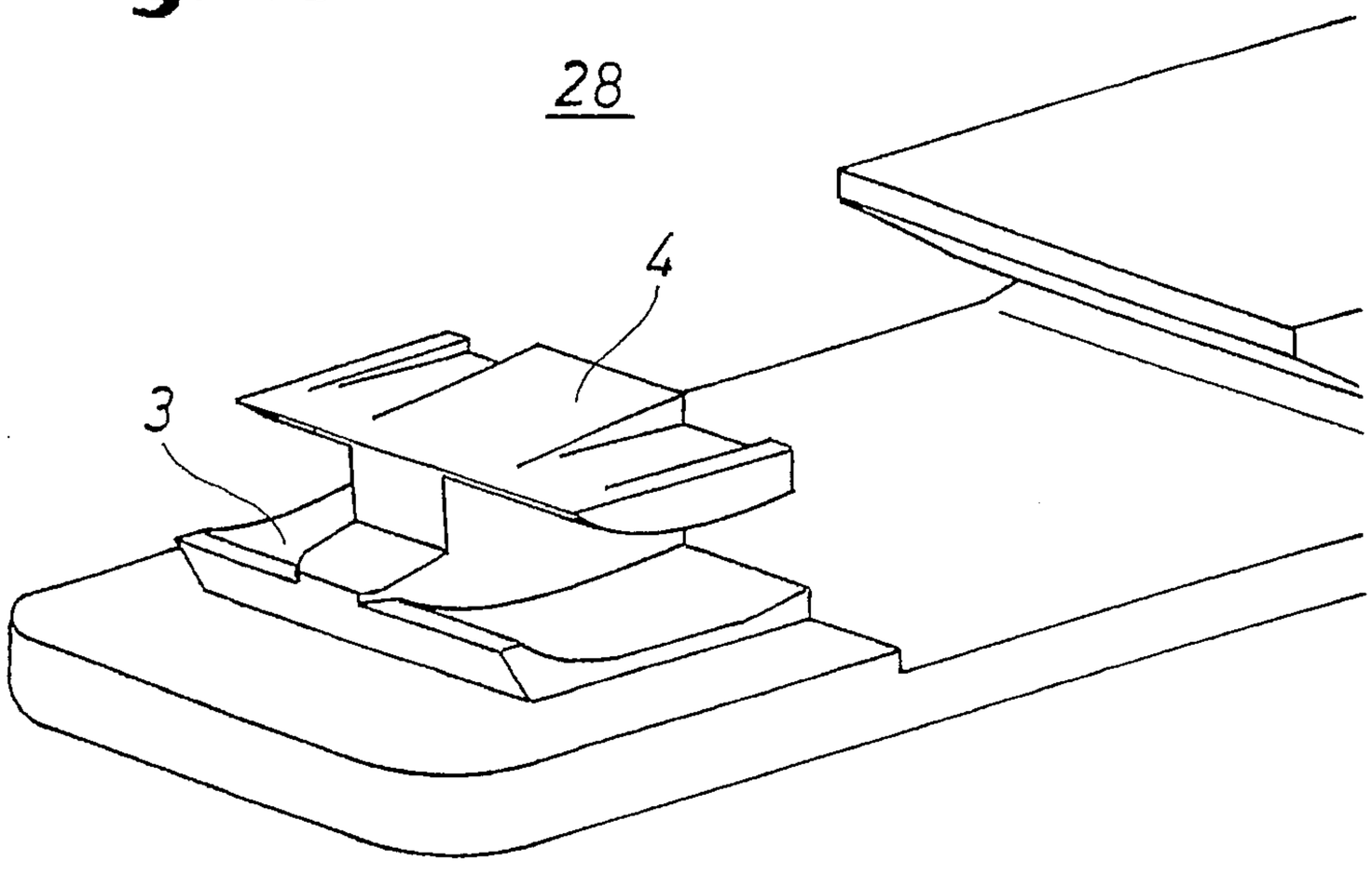


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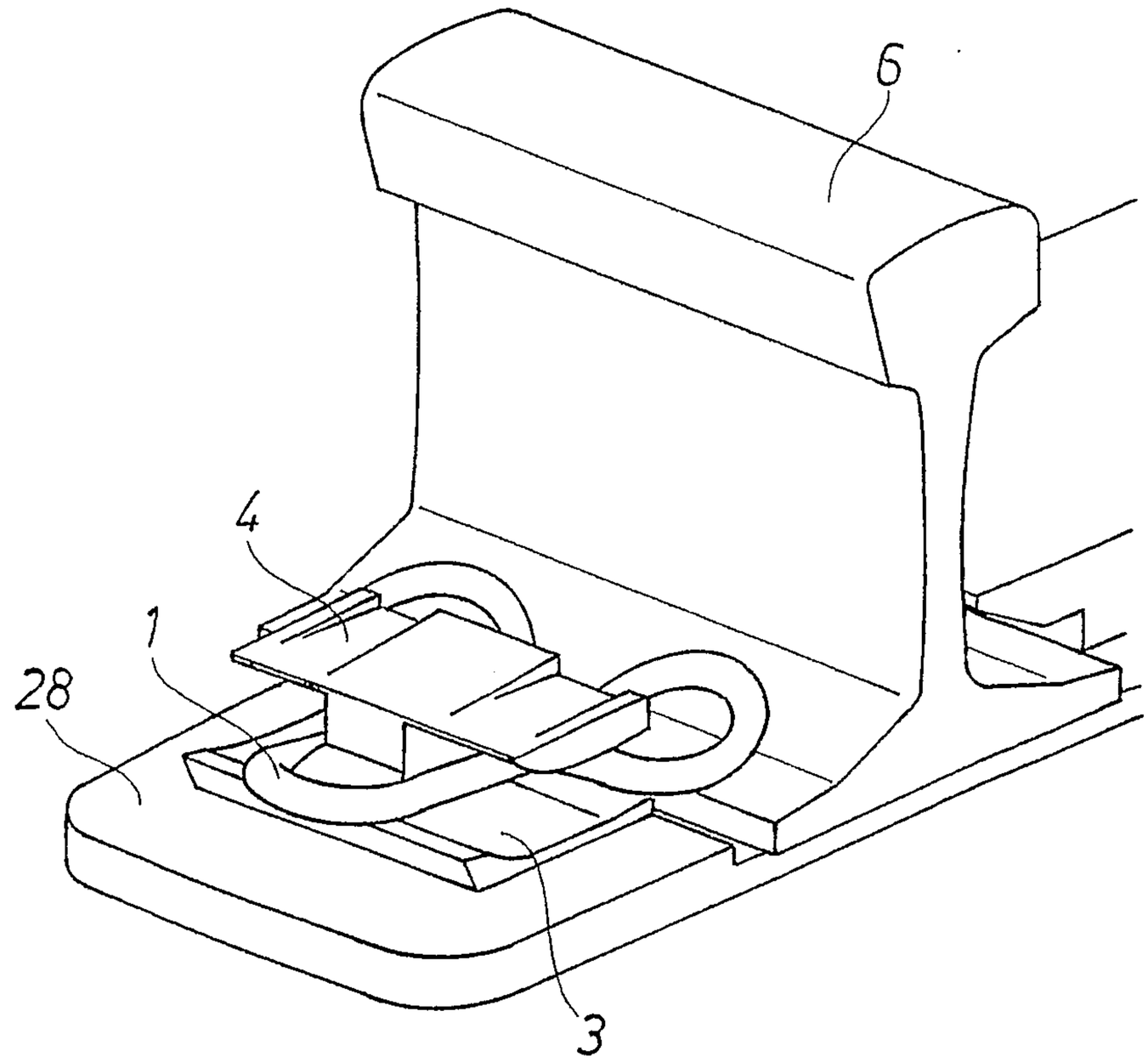


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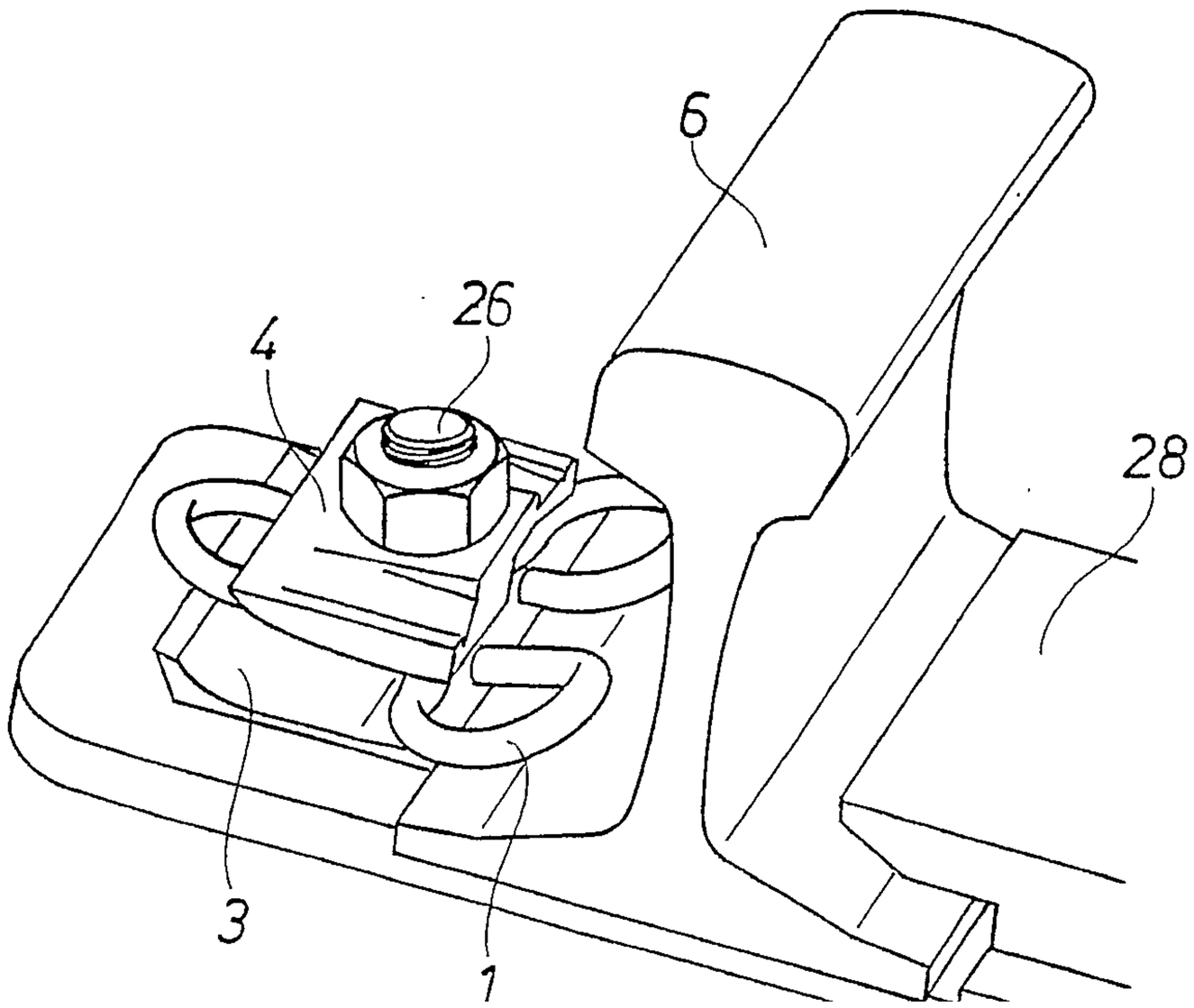


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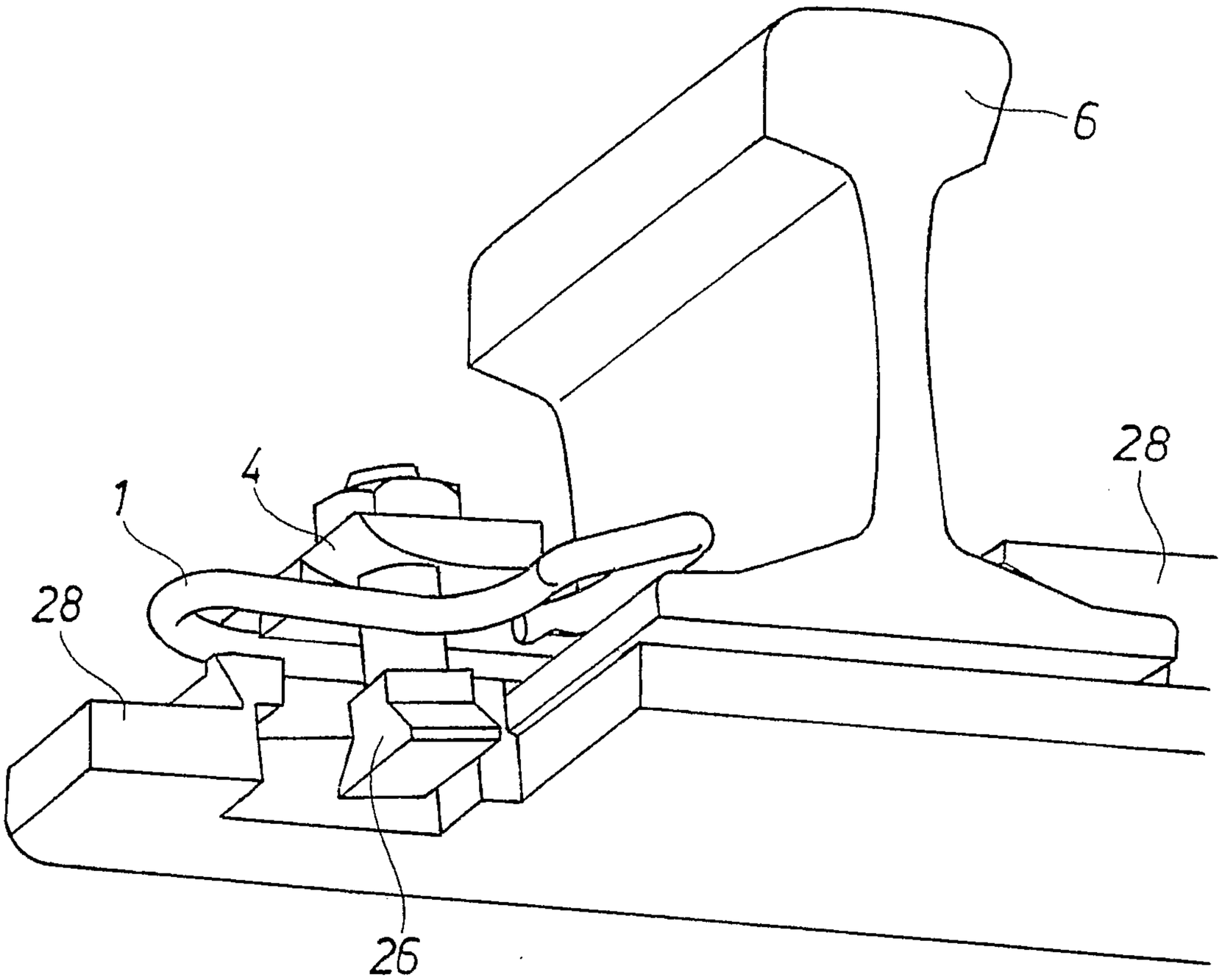


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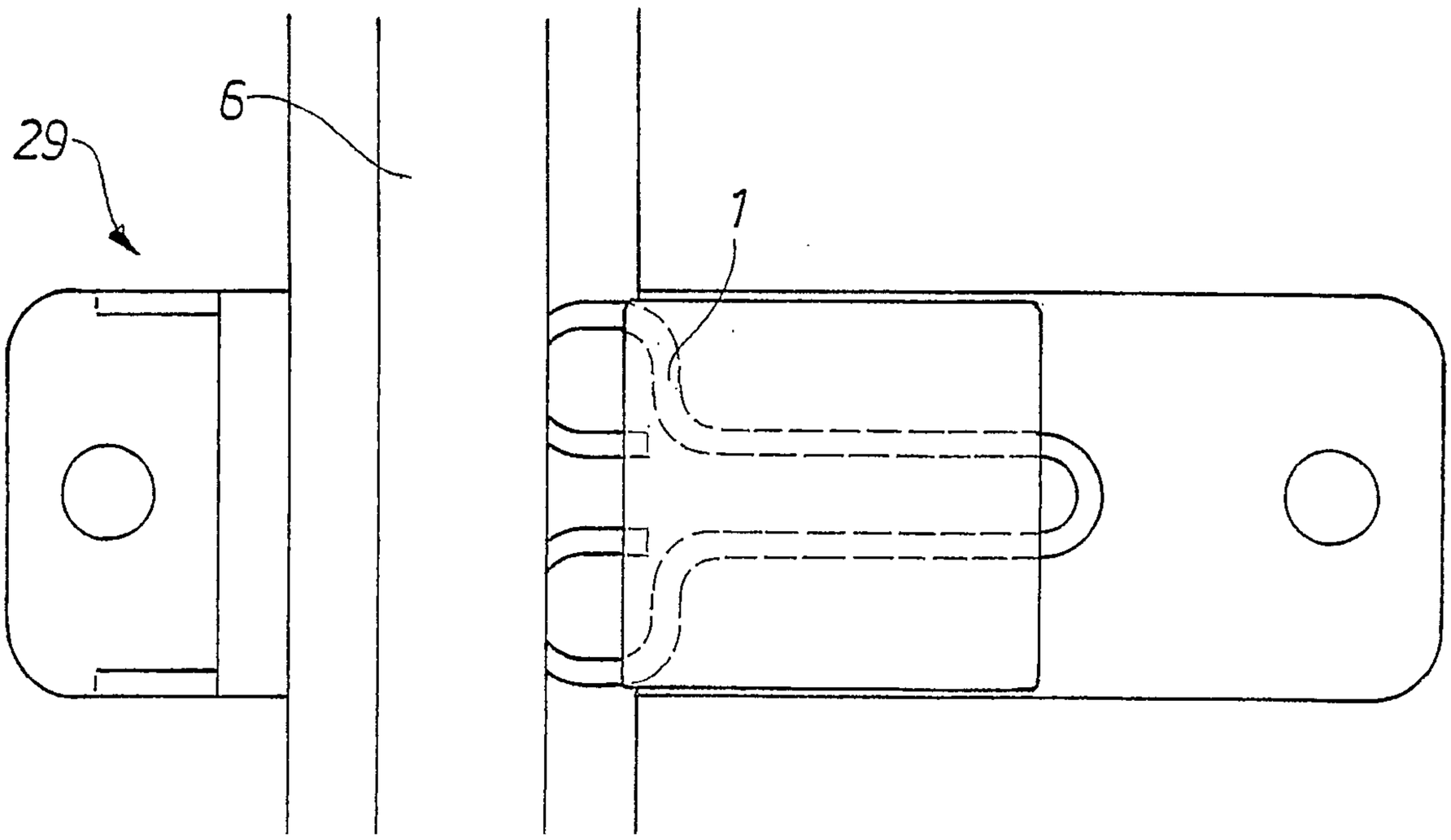


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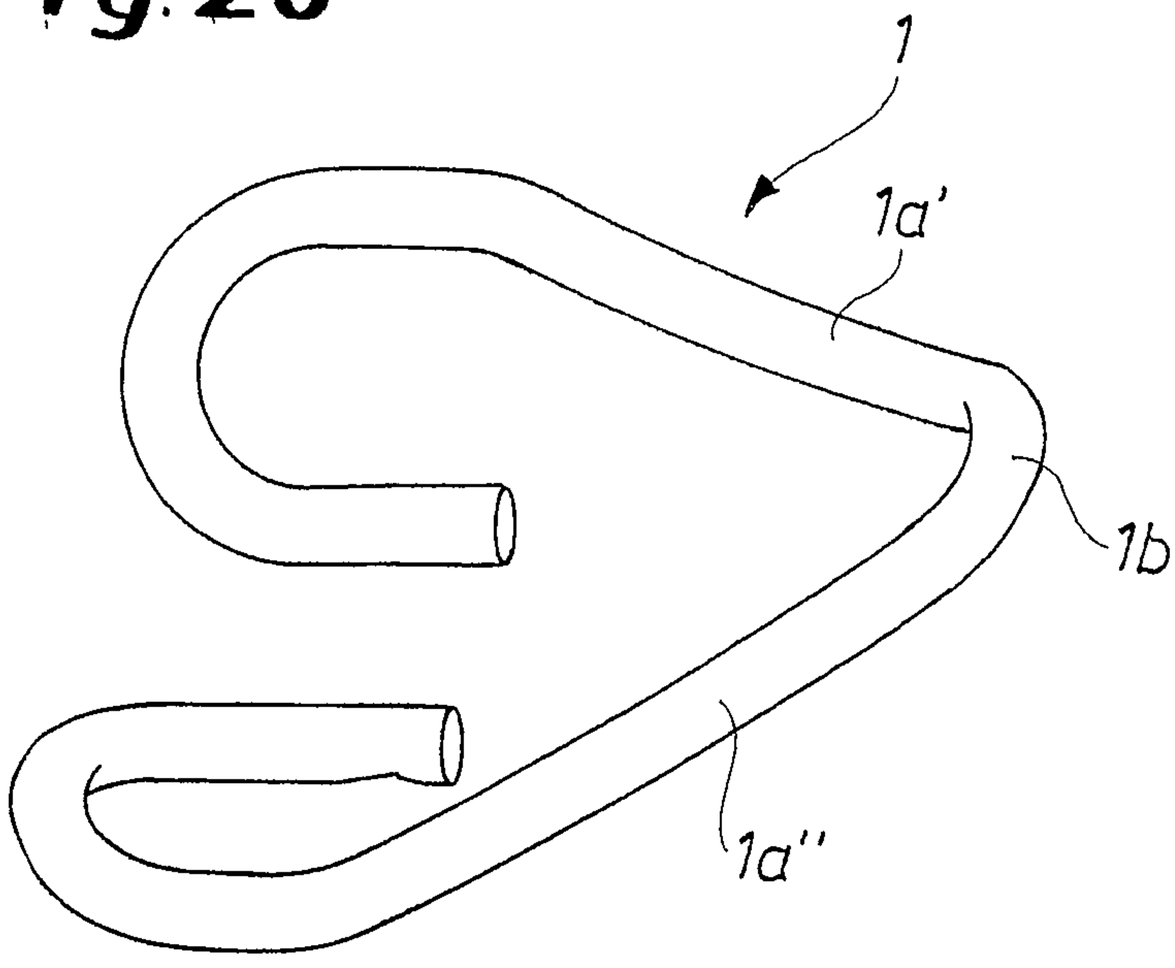


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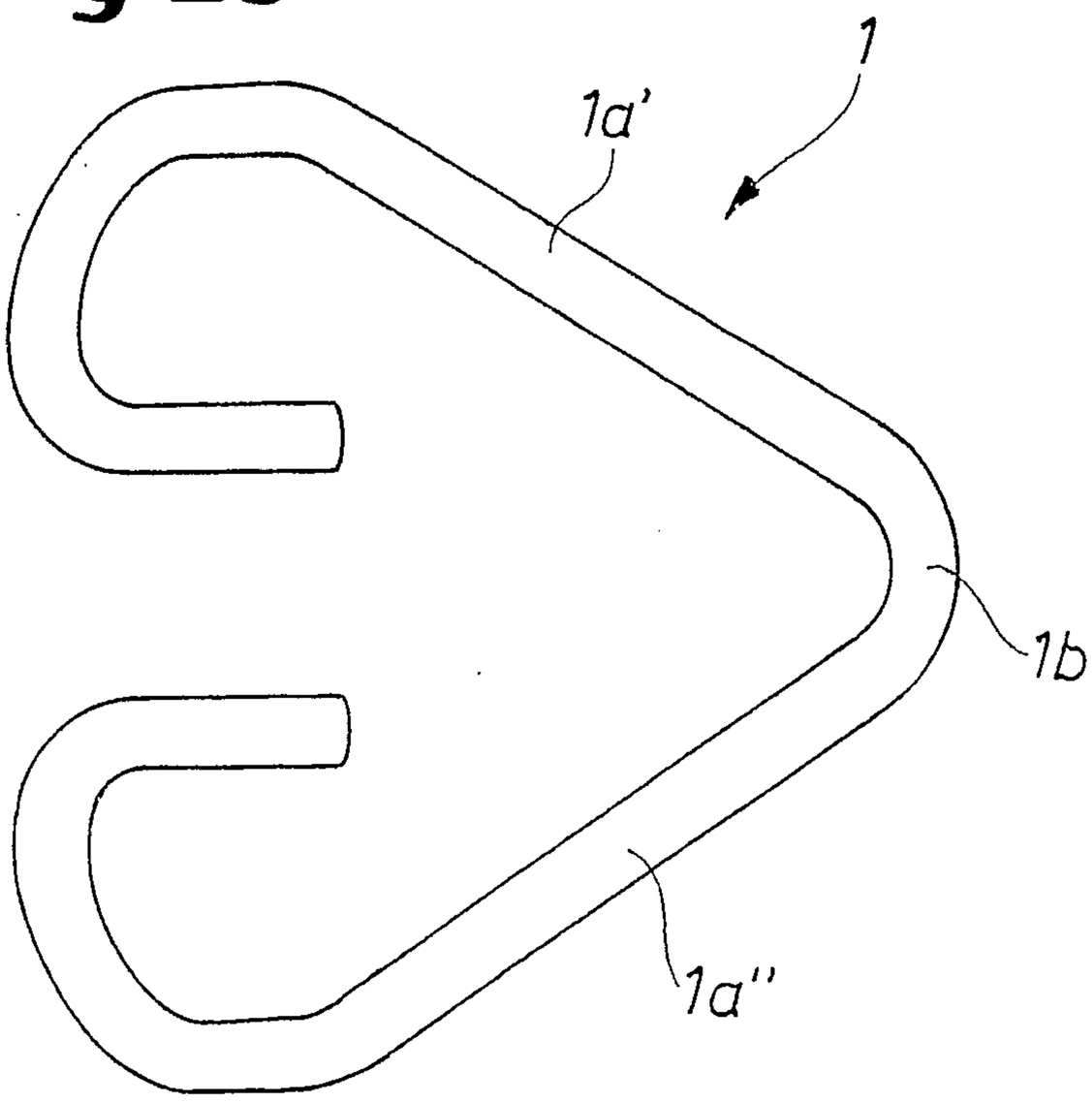


Fig. 30

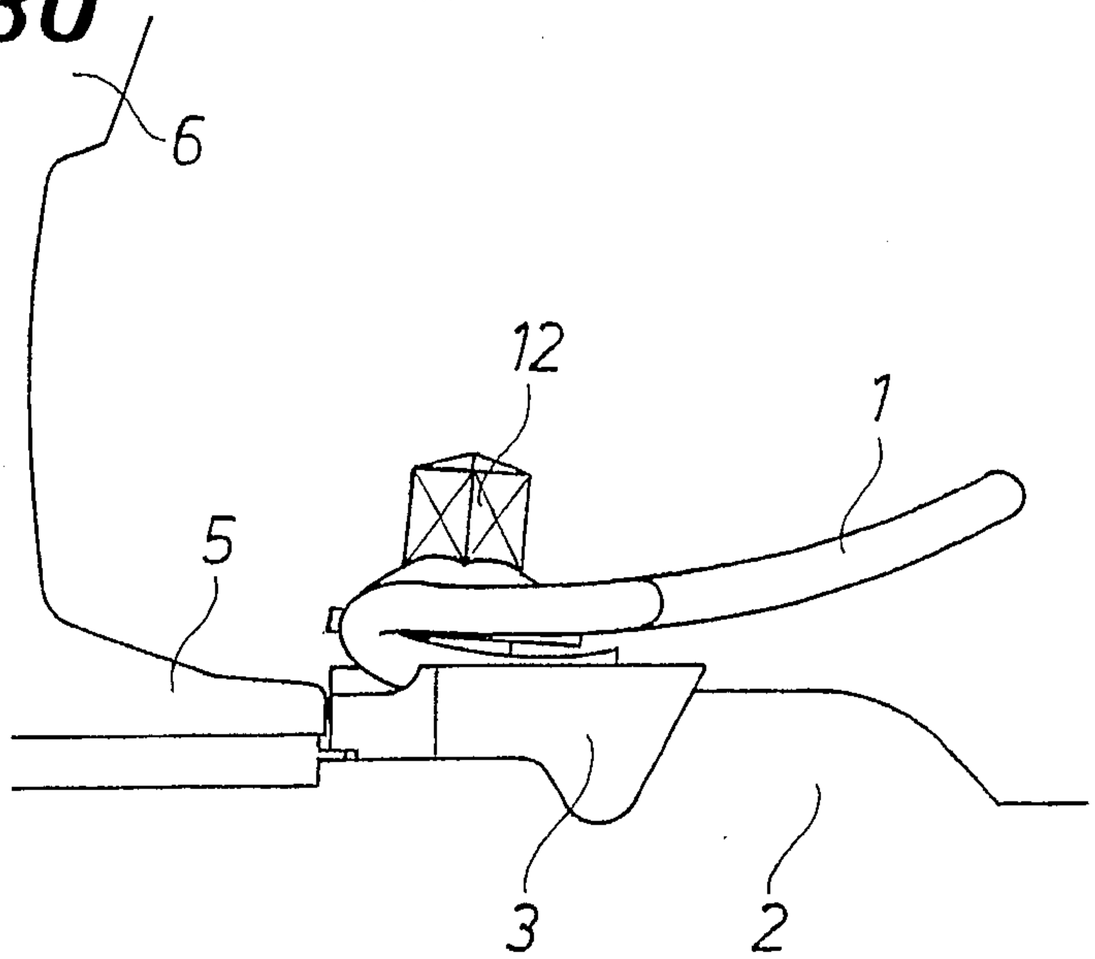


Fig. 31

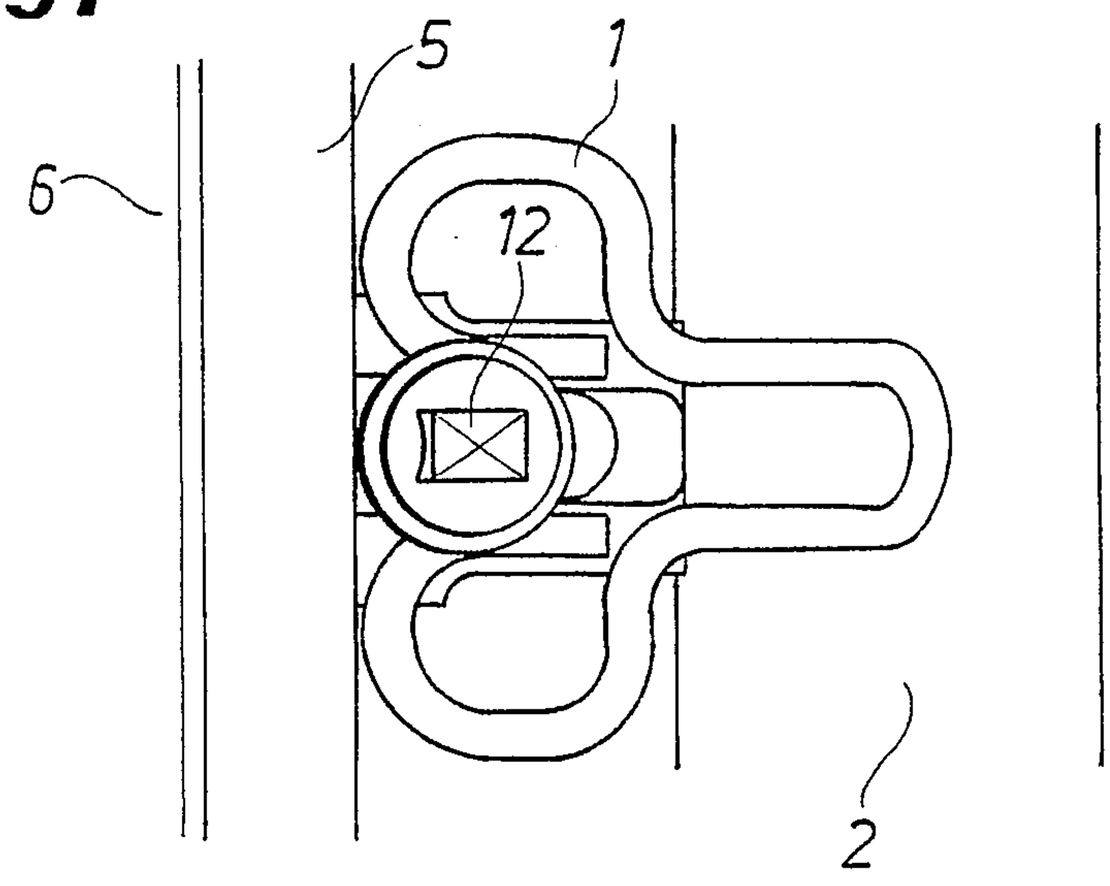


Fig. 32

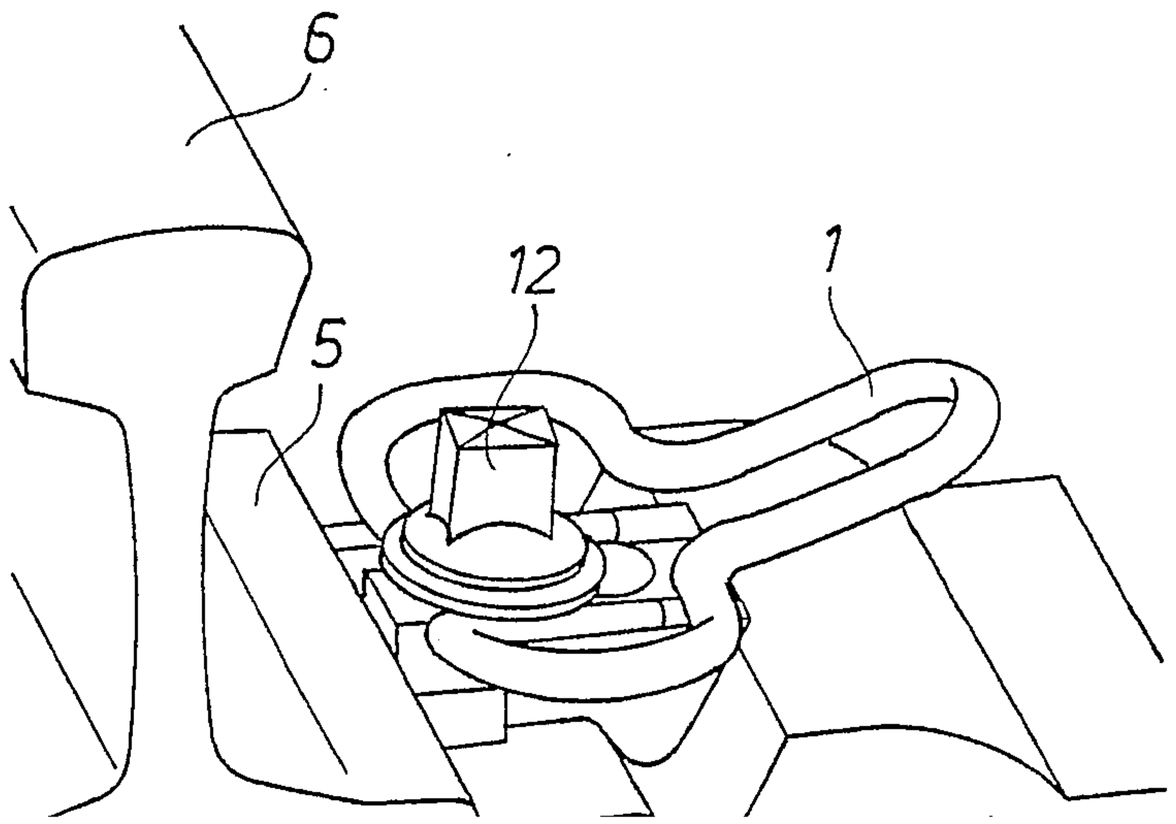


Fig. 33

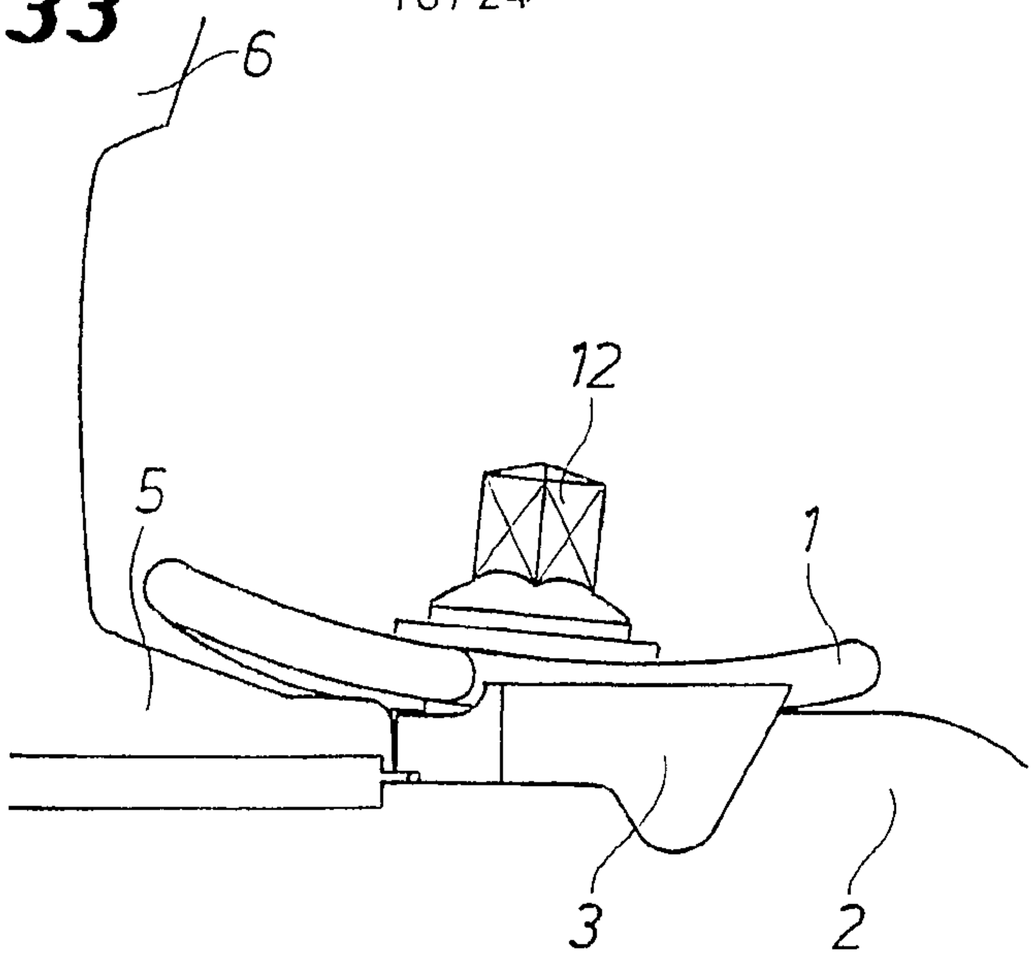


Fig. 34

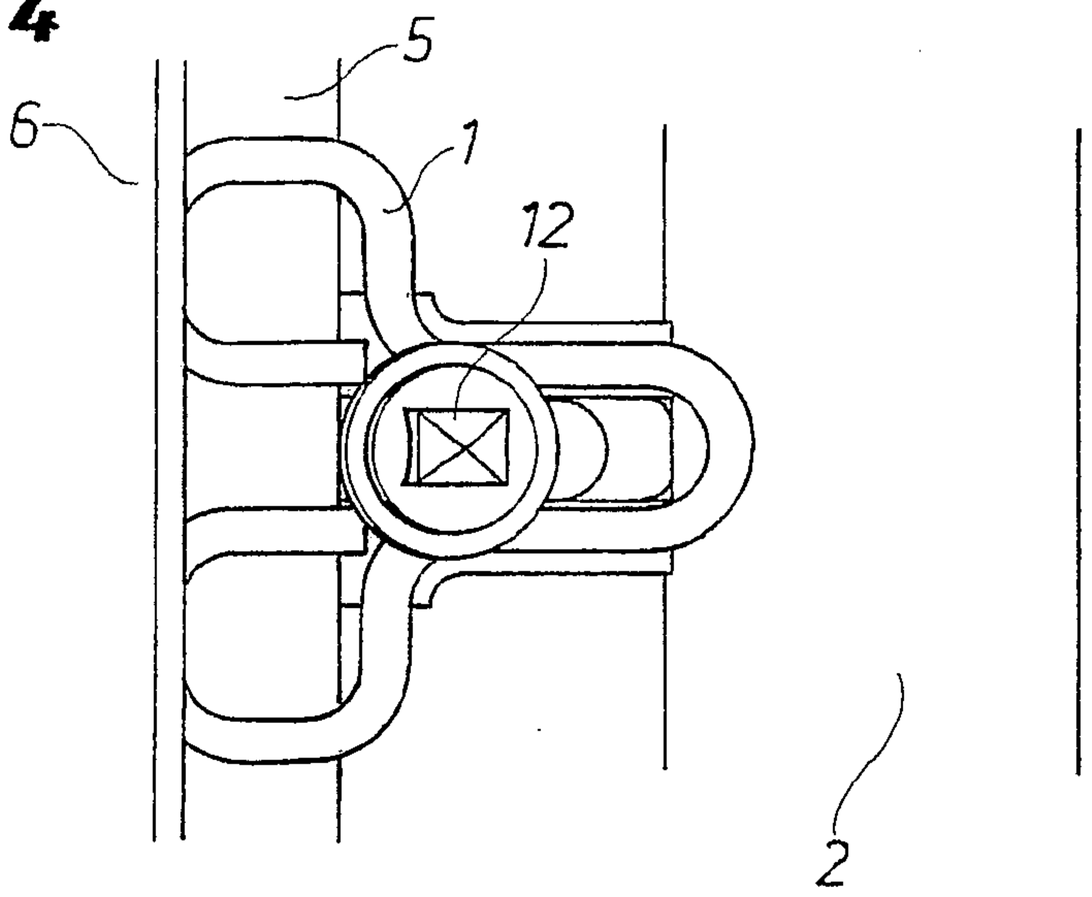


Fig. 35

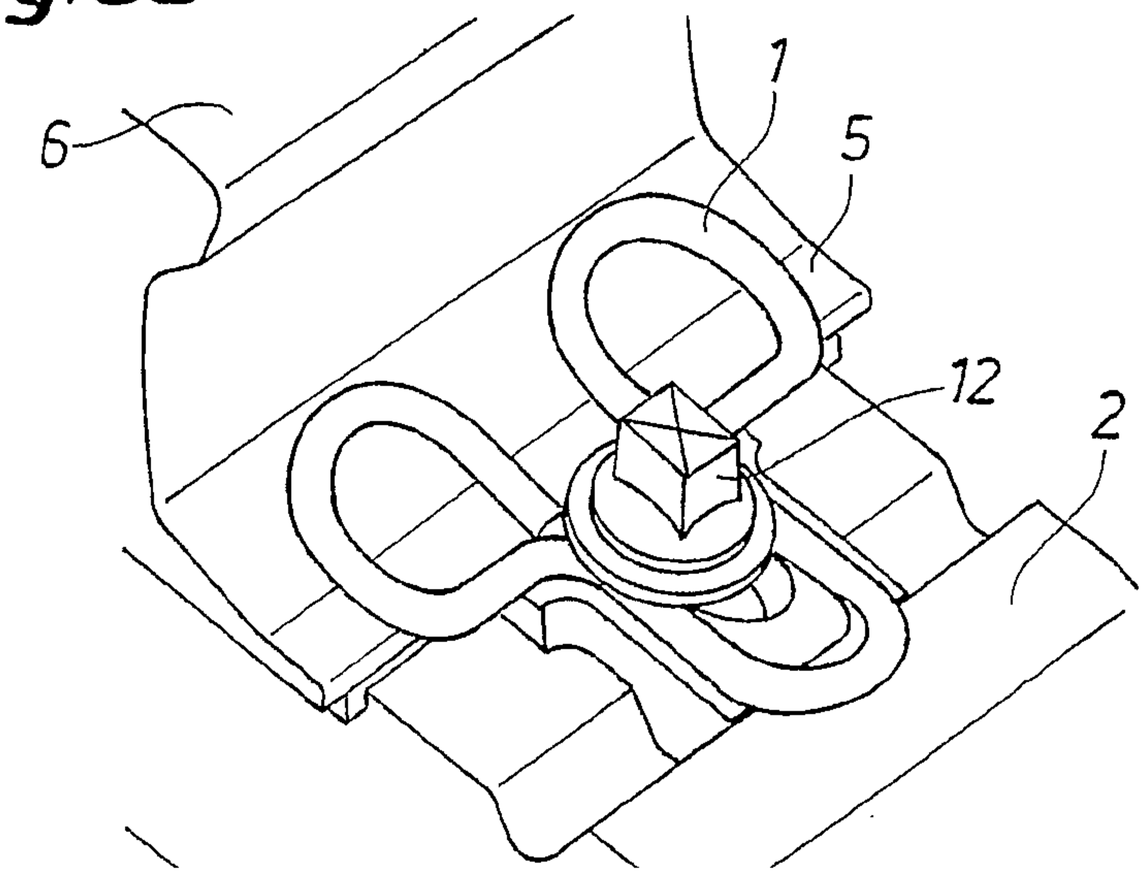


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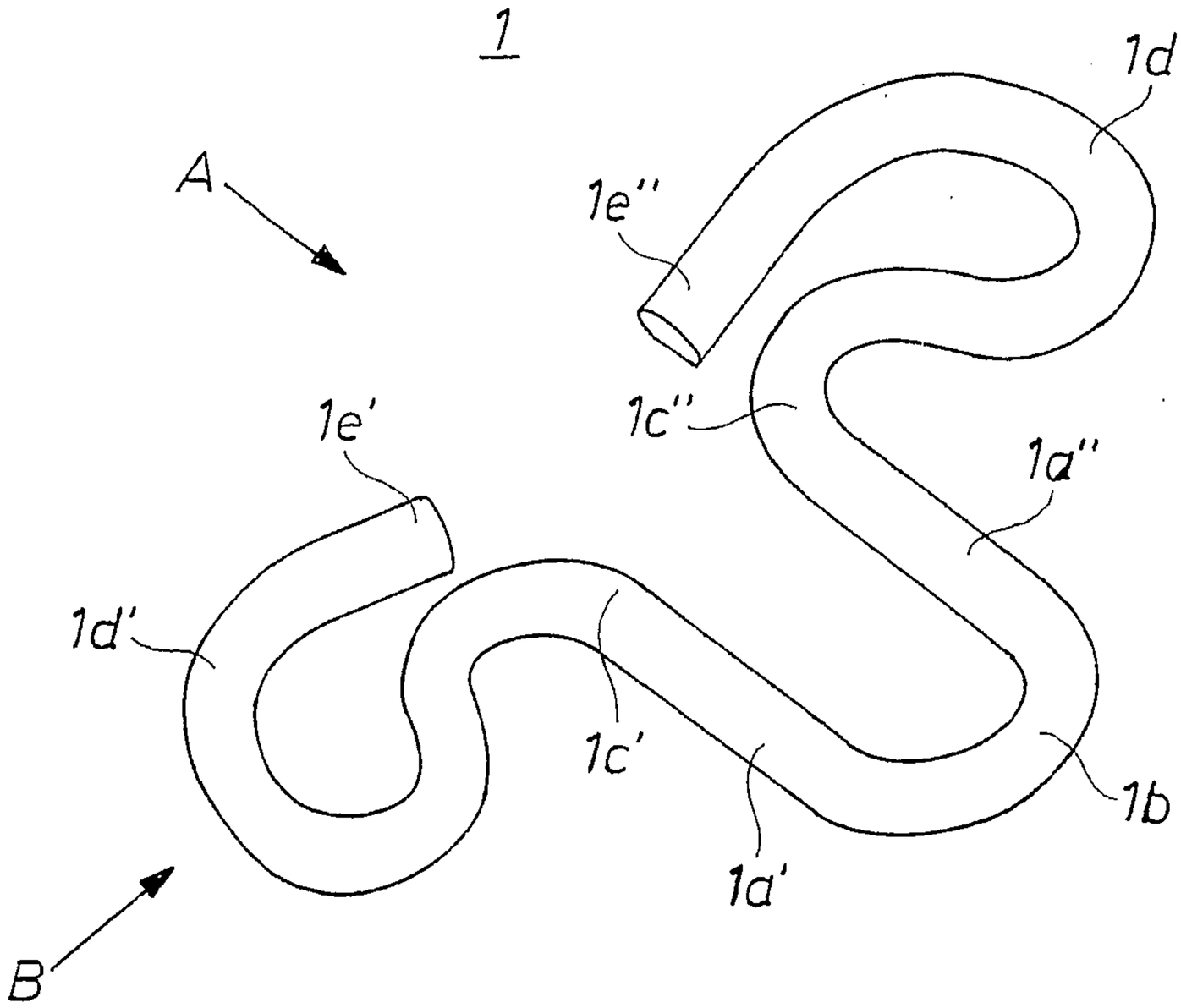


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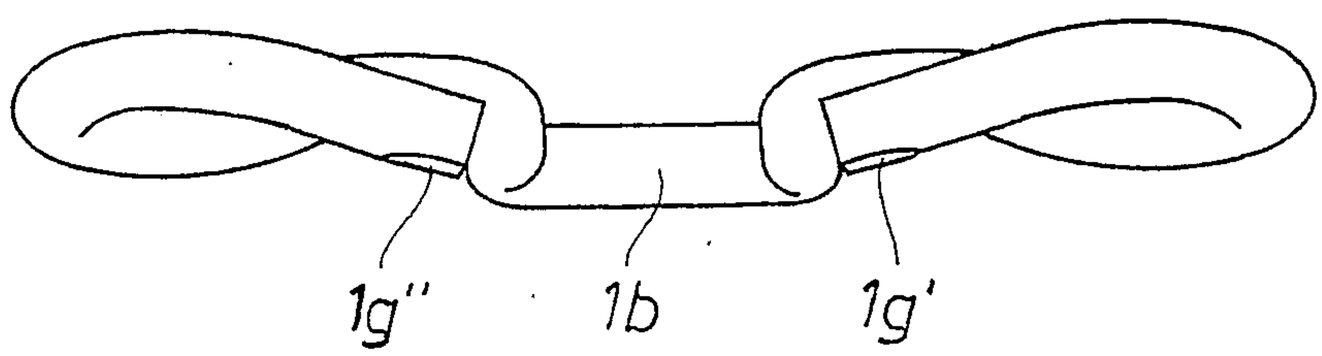


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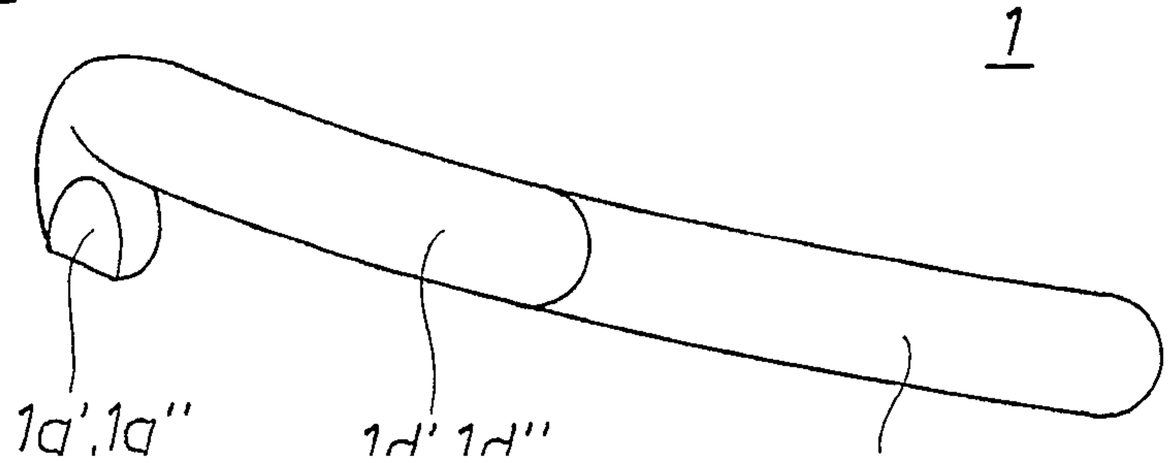


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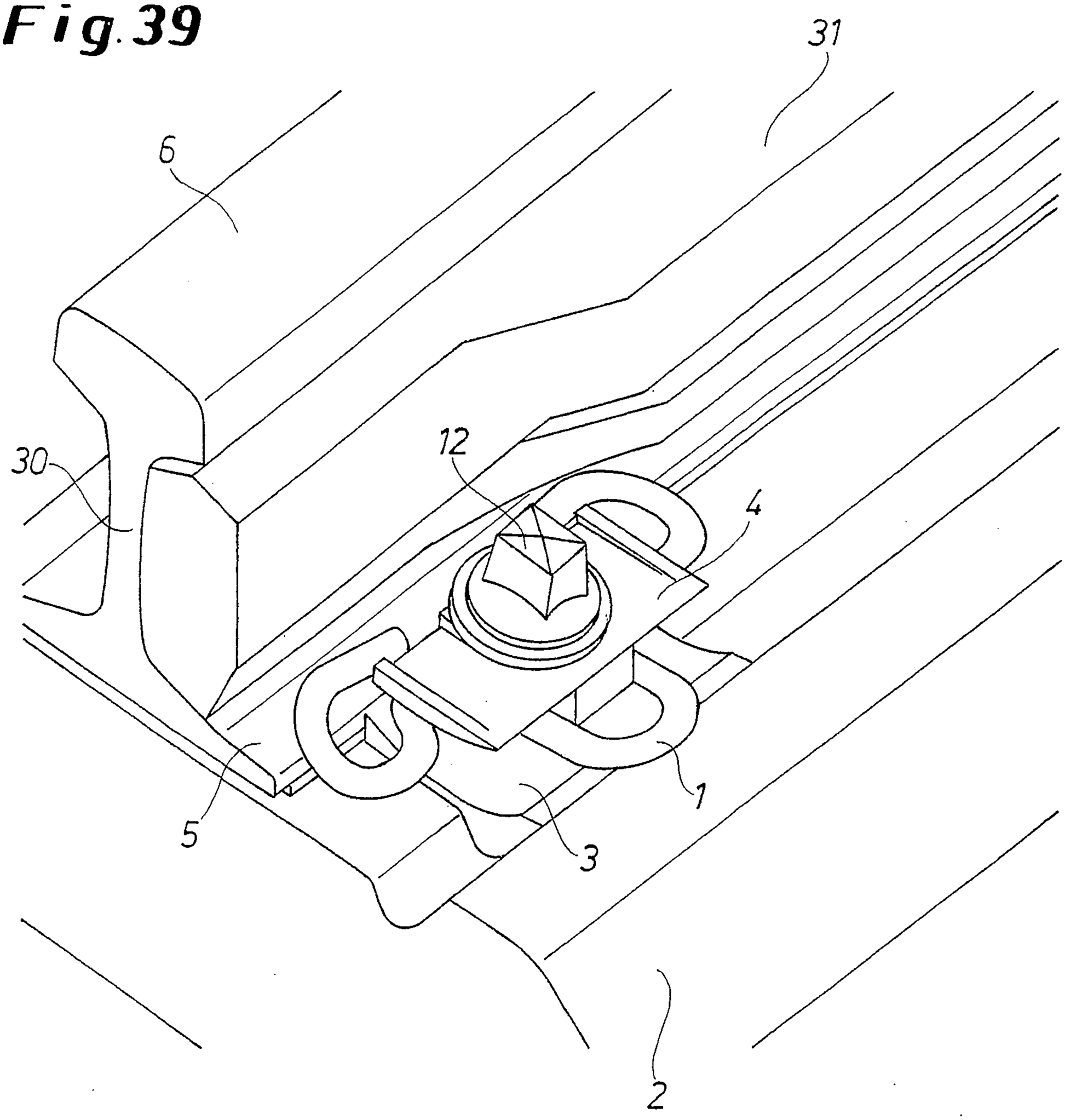


Fig.40

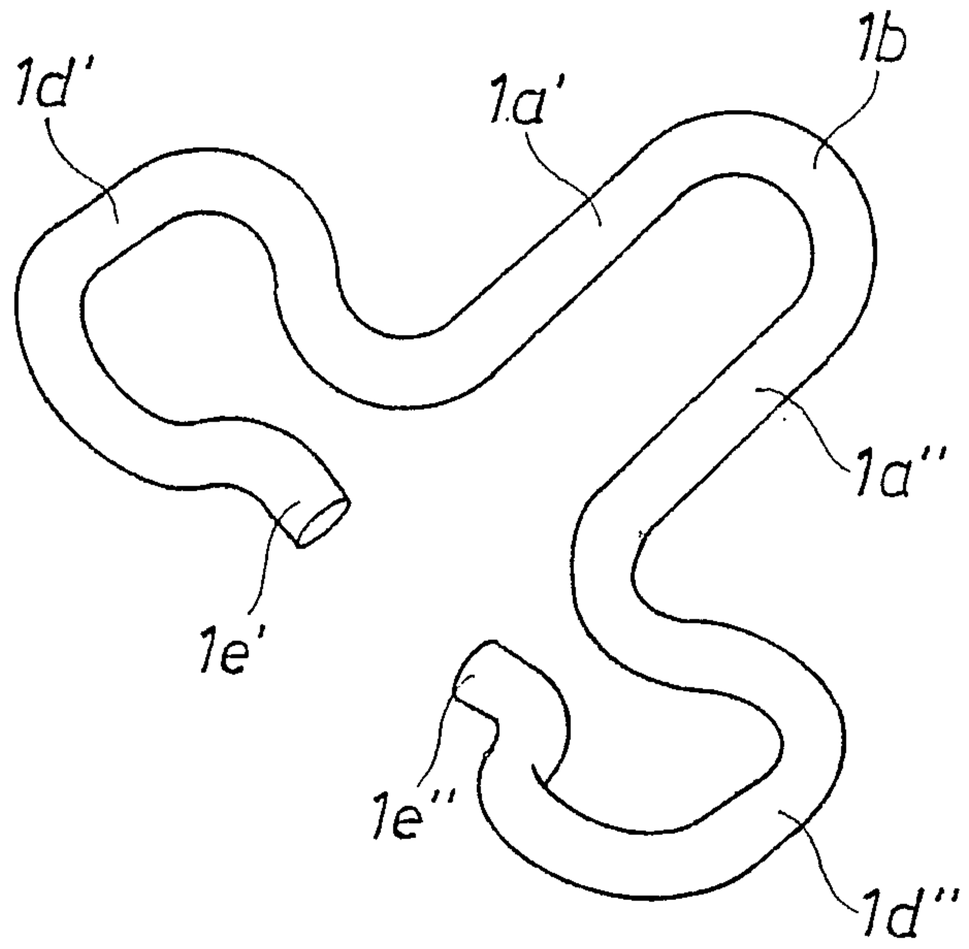


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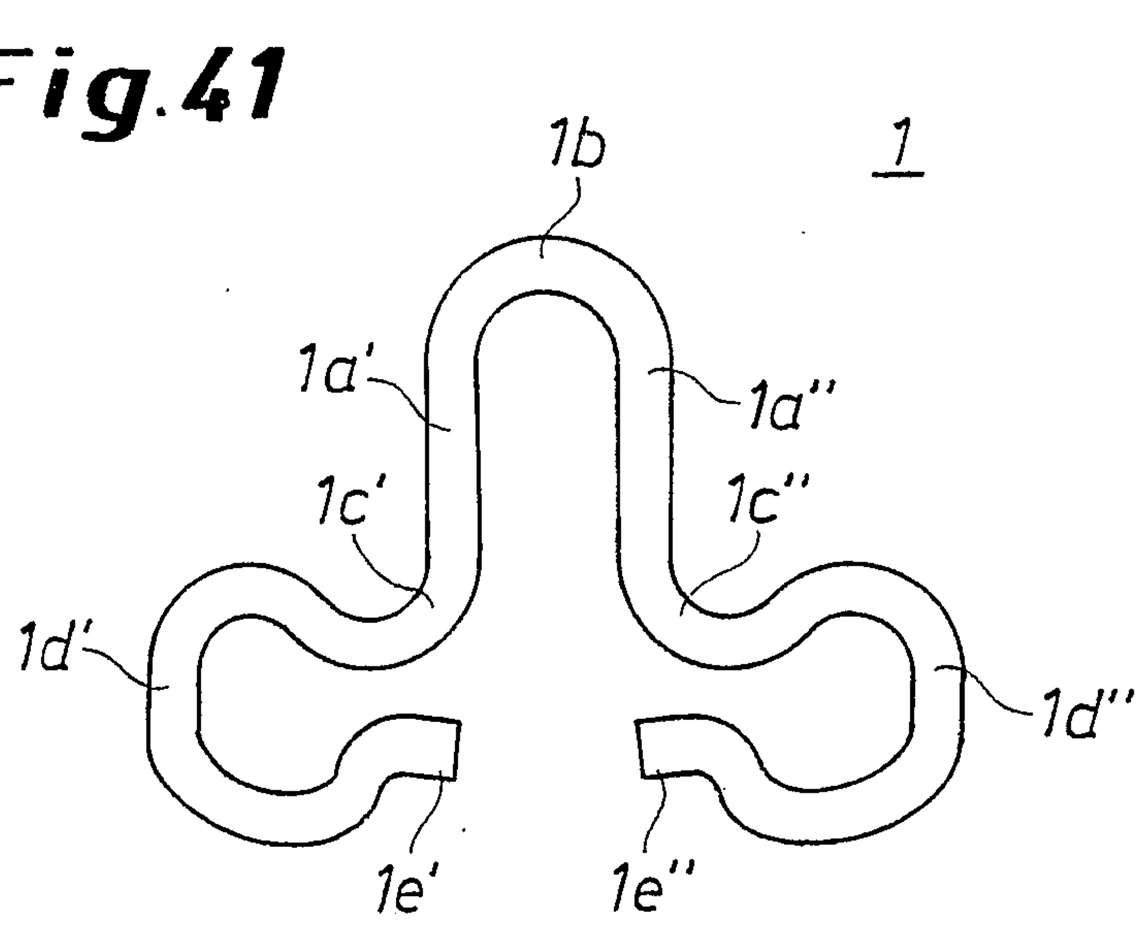


Fig.42

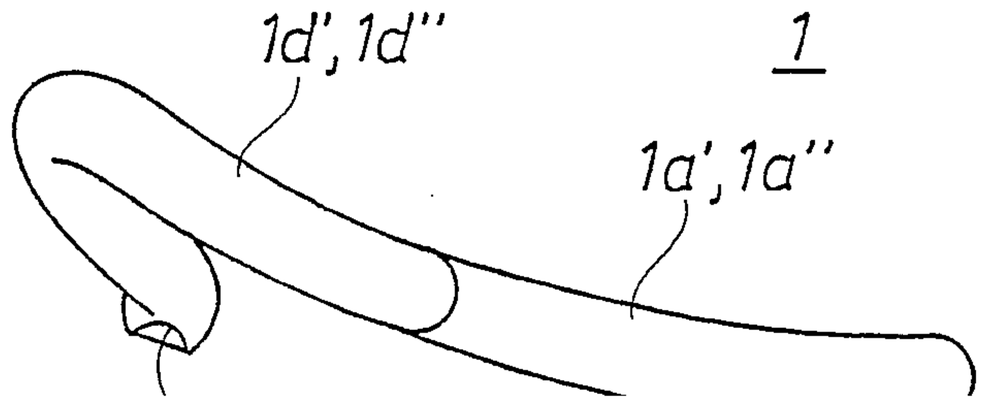


Fig.43

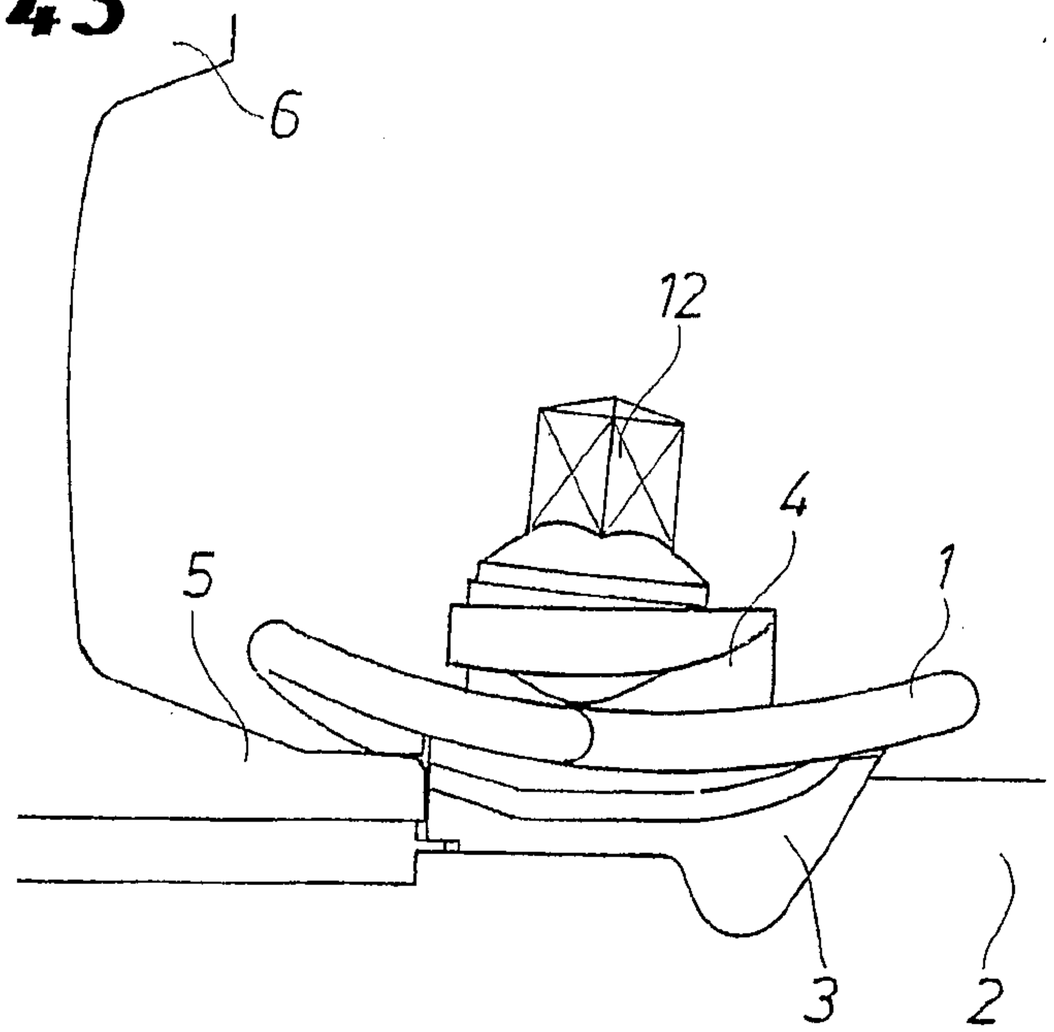


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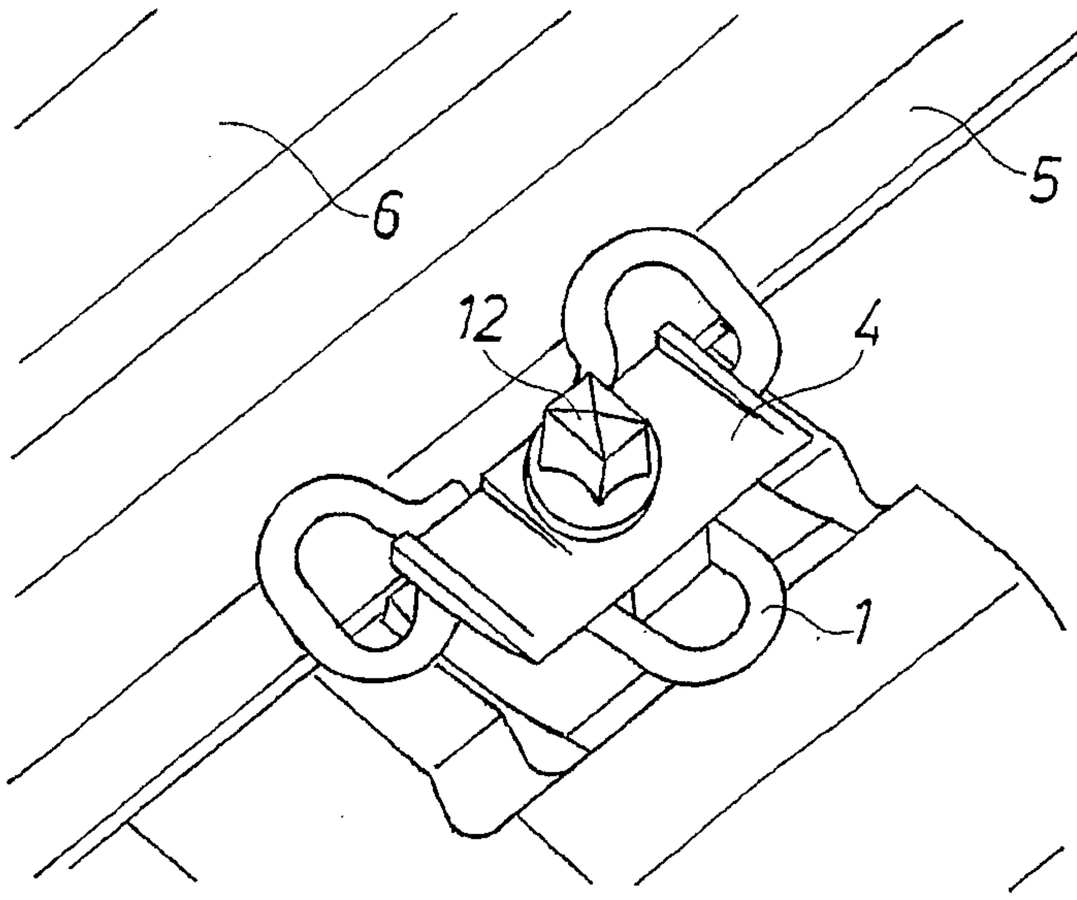


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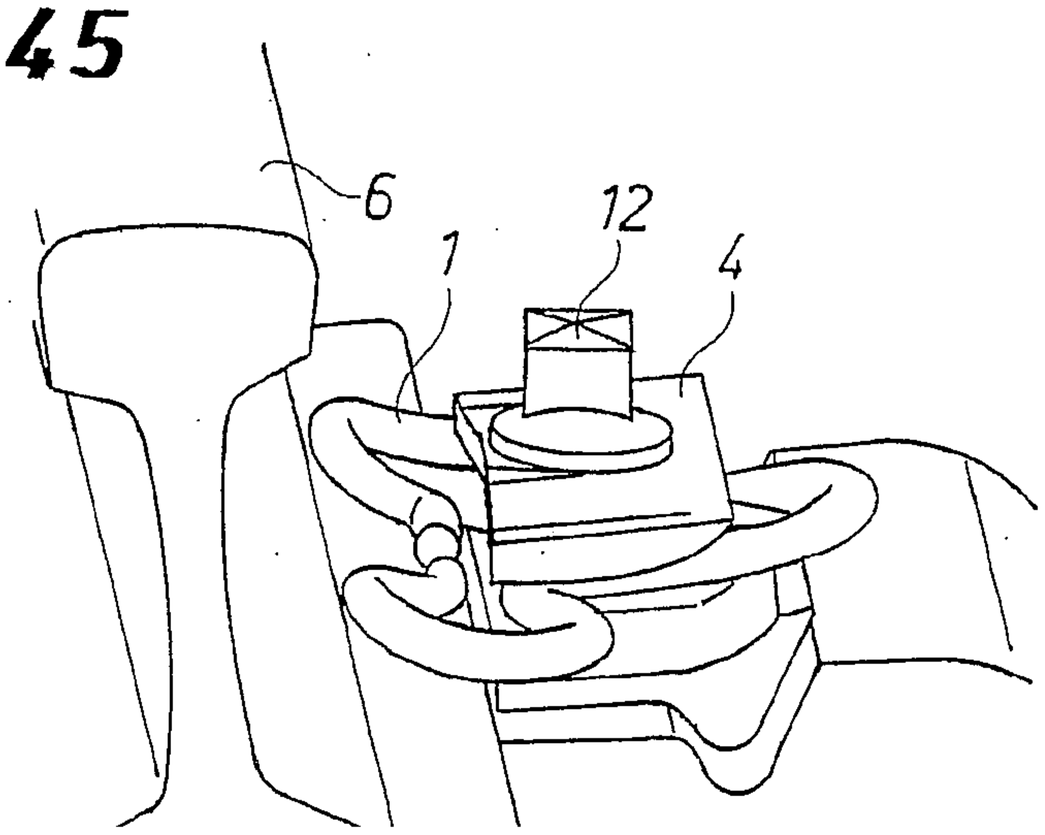


Fig. 46

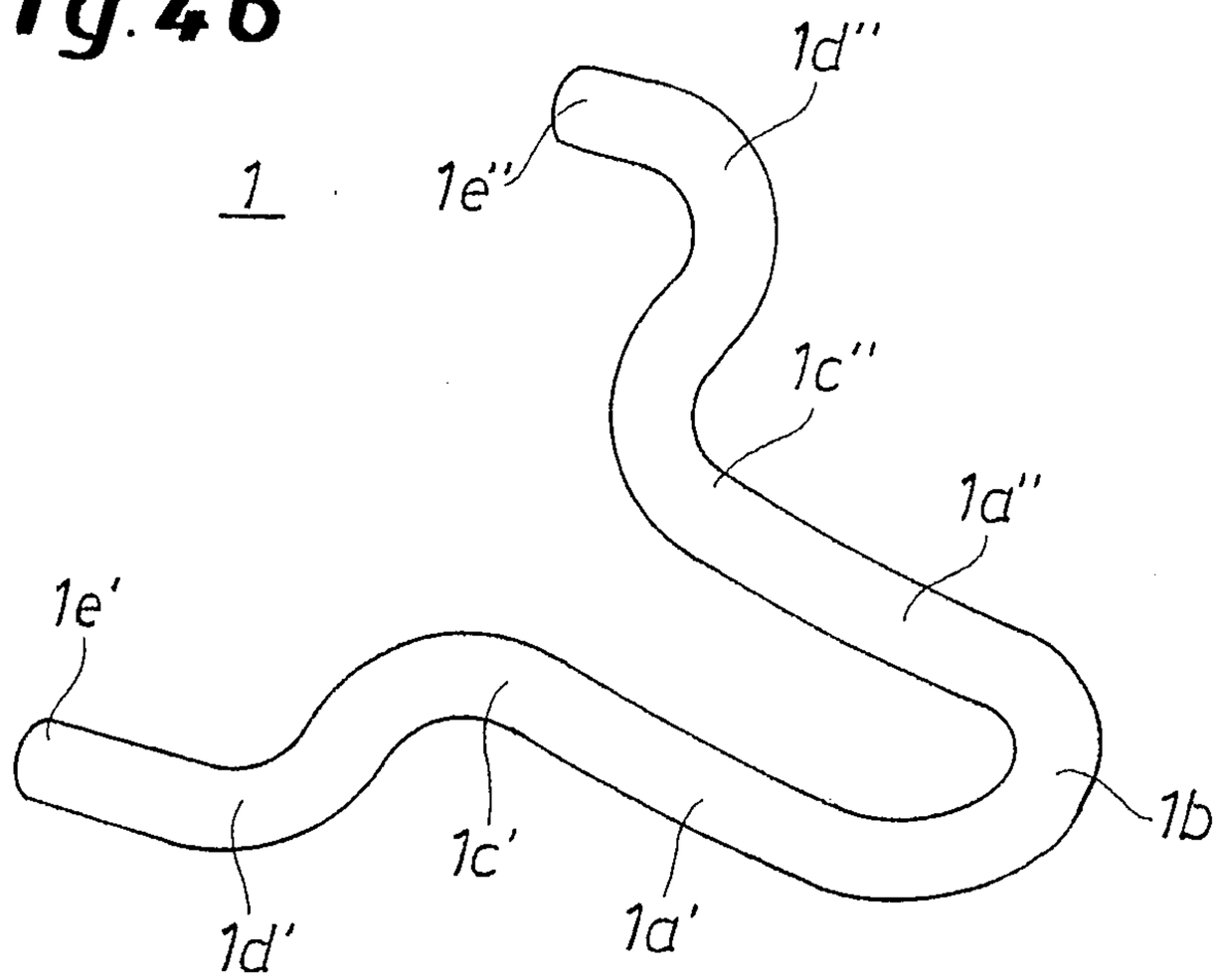


Fig. 47

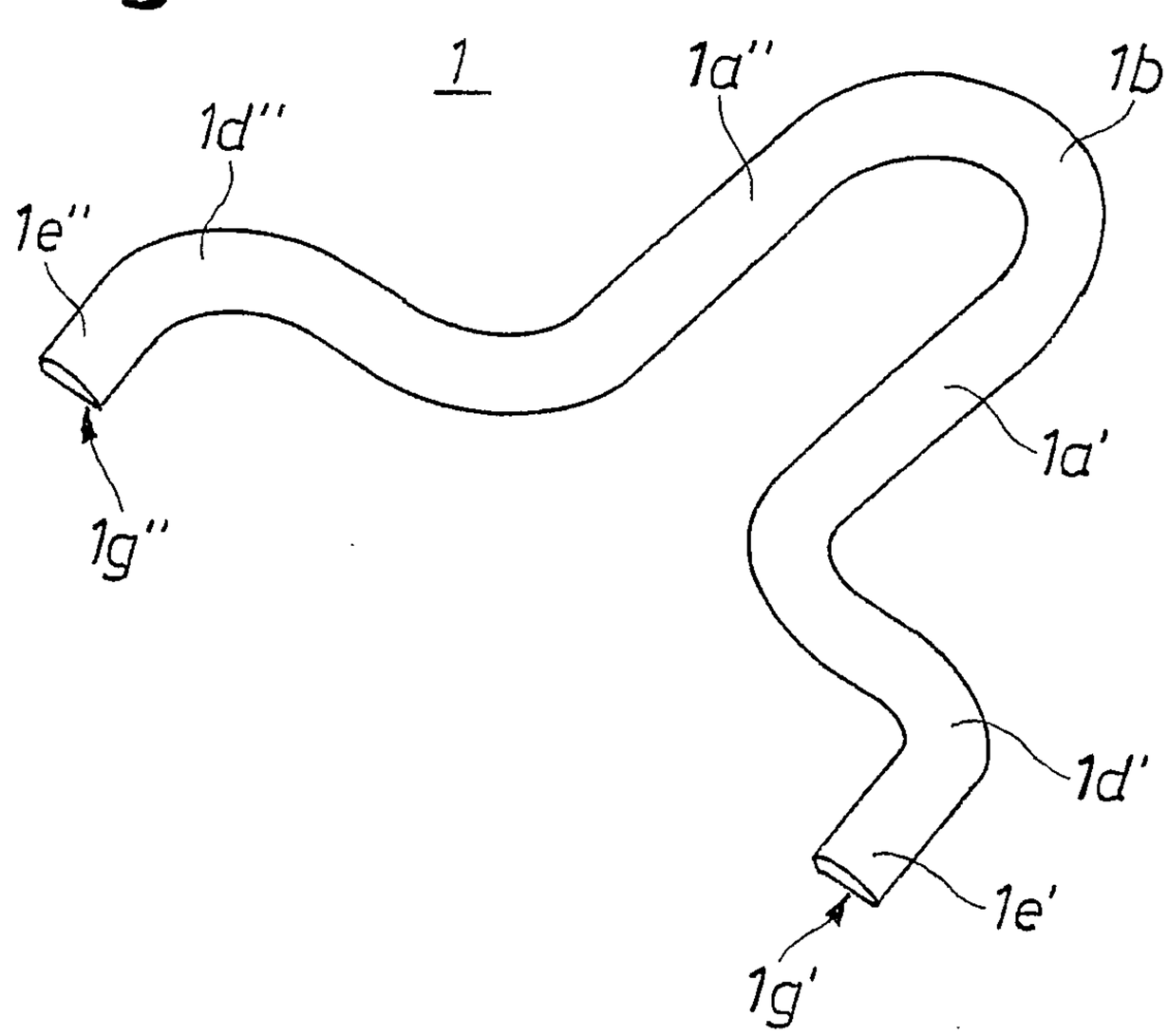


Fig. 48

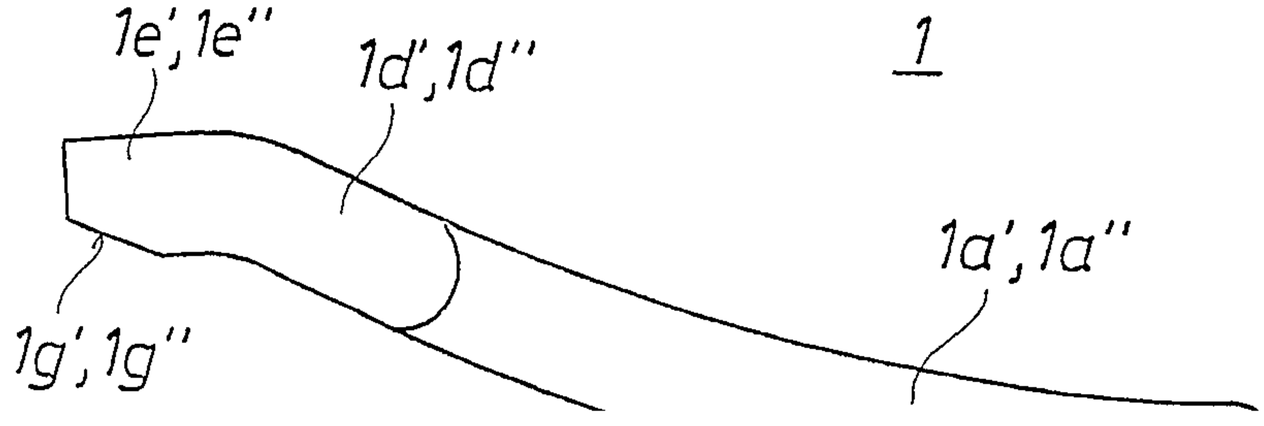


Fig.49

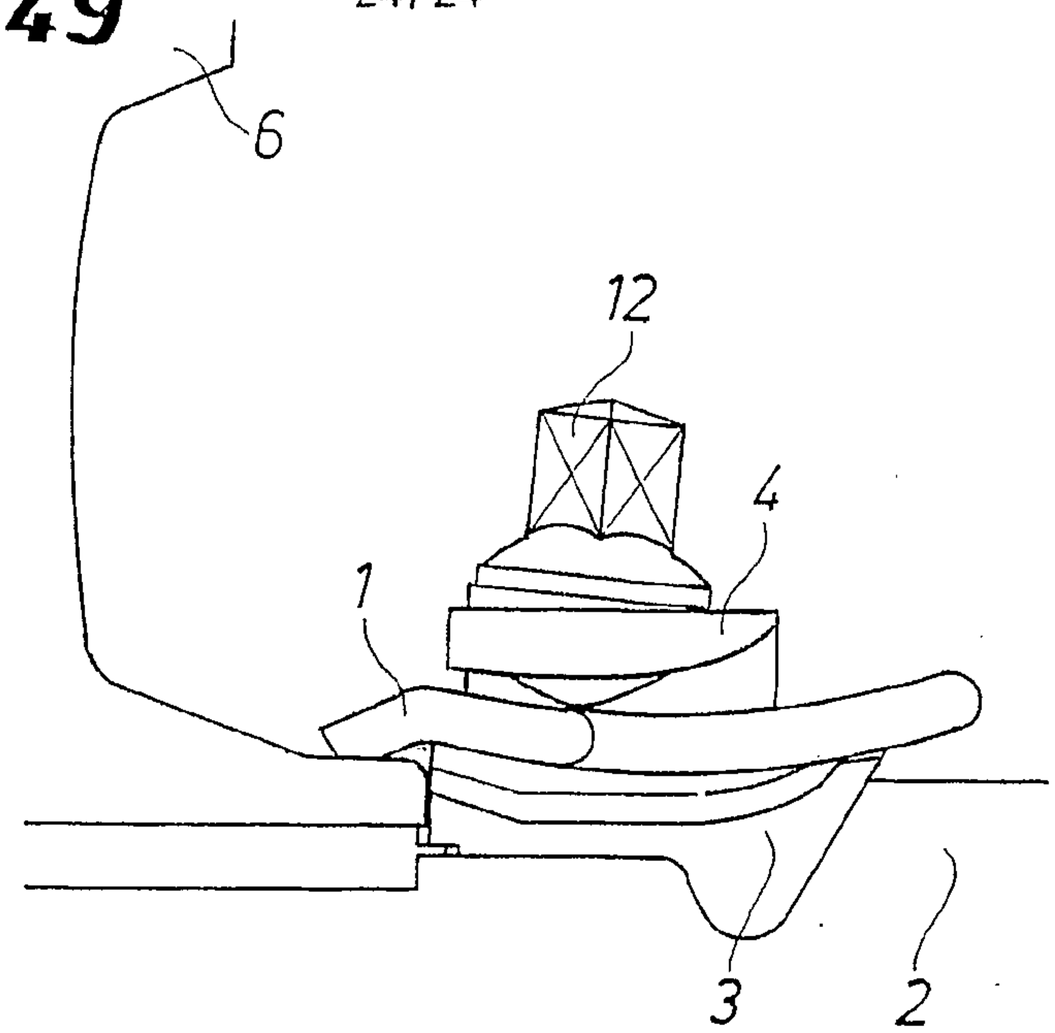


Fig.50

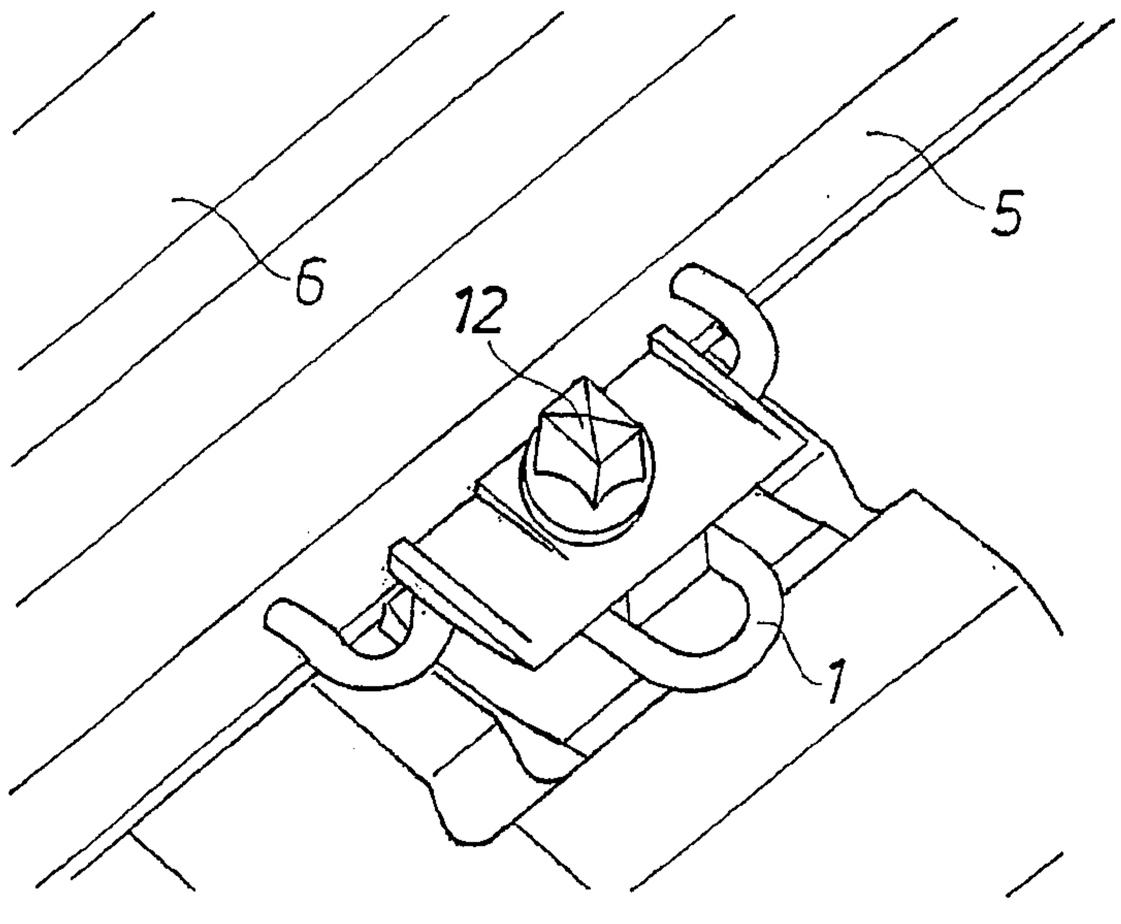
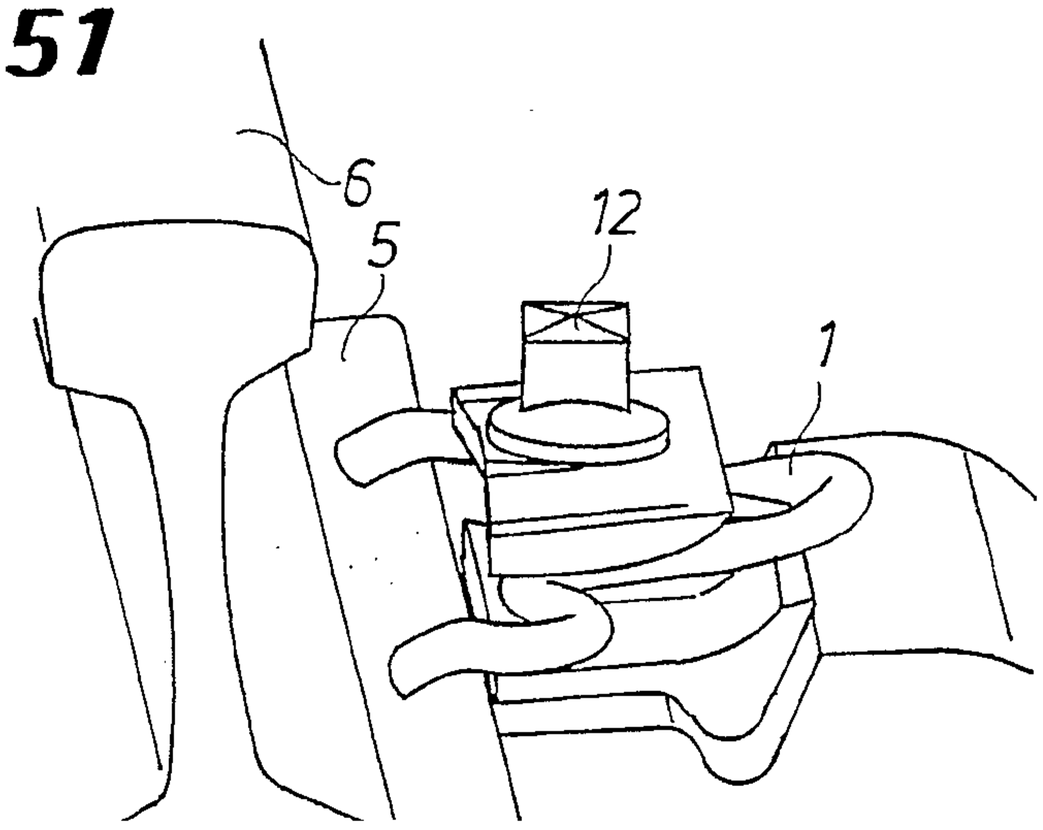
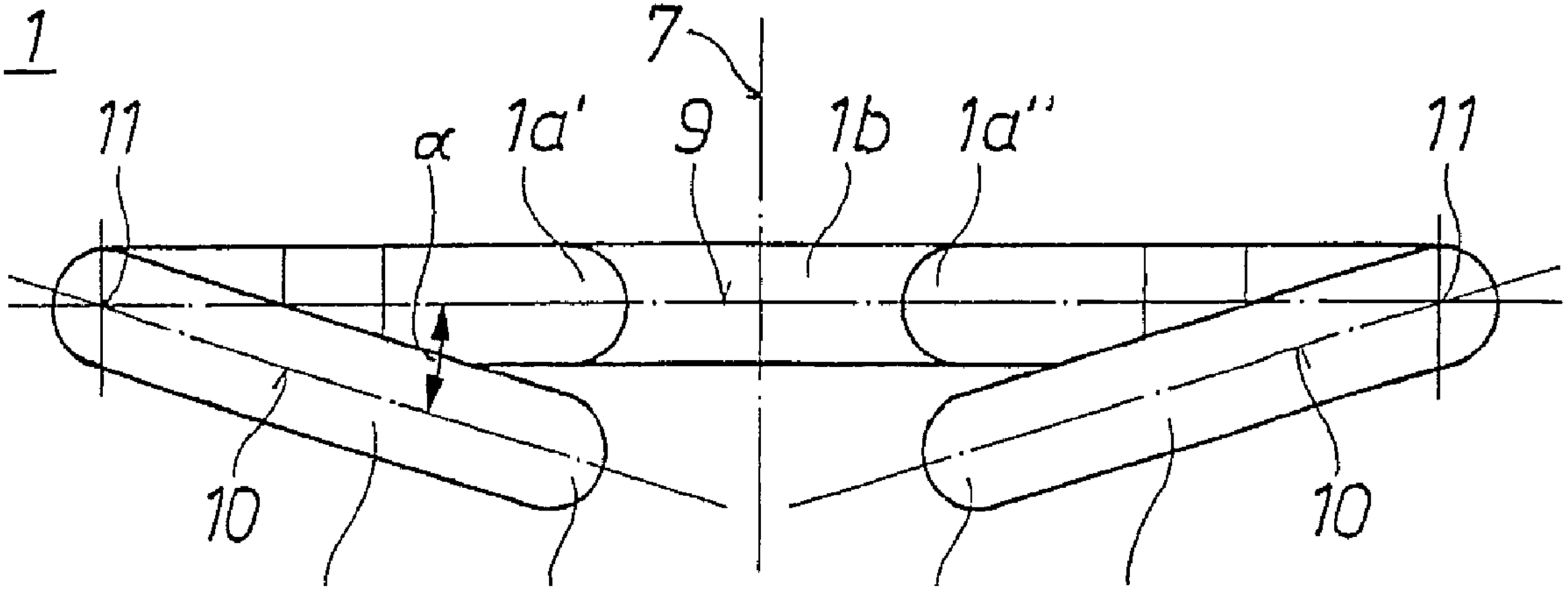


Fig.51




1
7
11
α
1a'
9
1b
1a''
11
10
10