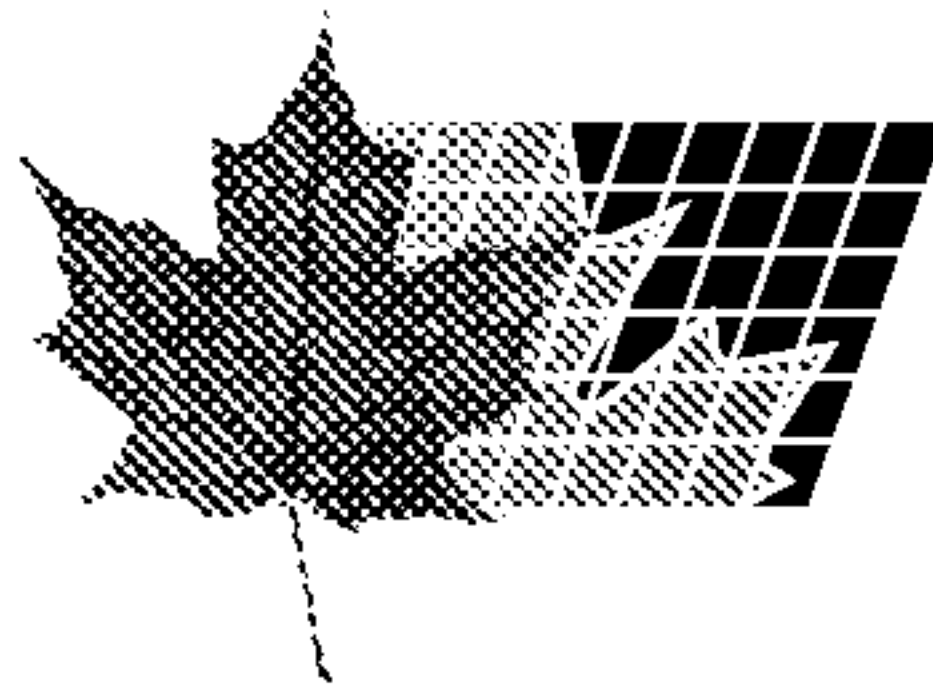




(11) (21) (C) **2,164,115**
(86) 1994/06/02
(87) 1994/12/08
(45) 2000/02/22

(72) Igwemezie, Jude Odihachukwunma, CA

(73) Igwemezie, Jude Odihachukwunma, CA

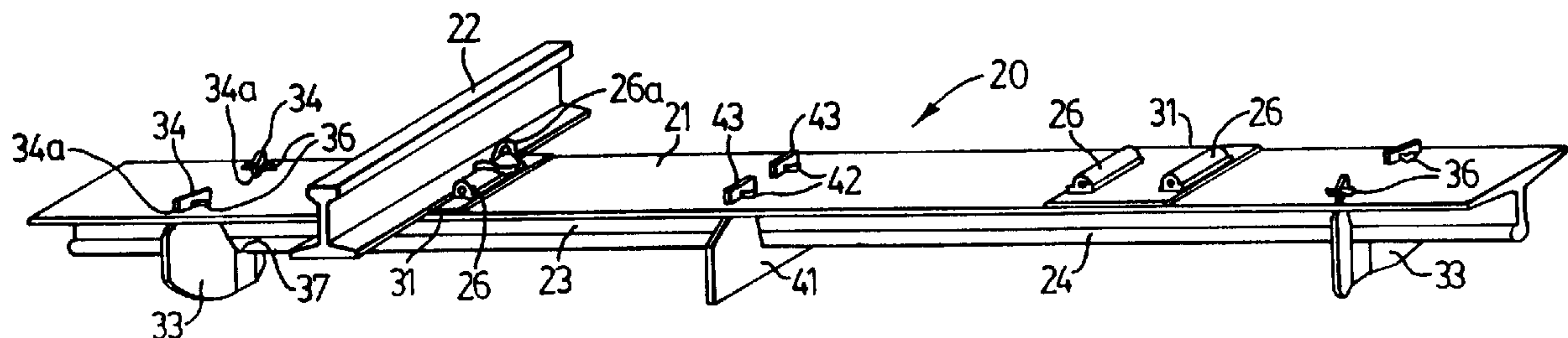
(51) Int.Cl.⁶ E01B 3/16, E01B 9/48, E01B 9/42

(30) 1993/06/02 (9311396.7) GB

(30) 1993/10/22 (08/139,736) US

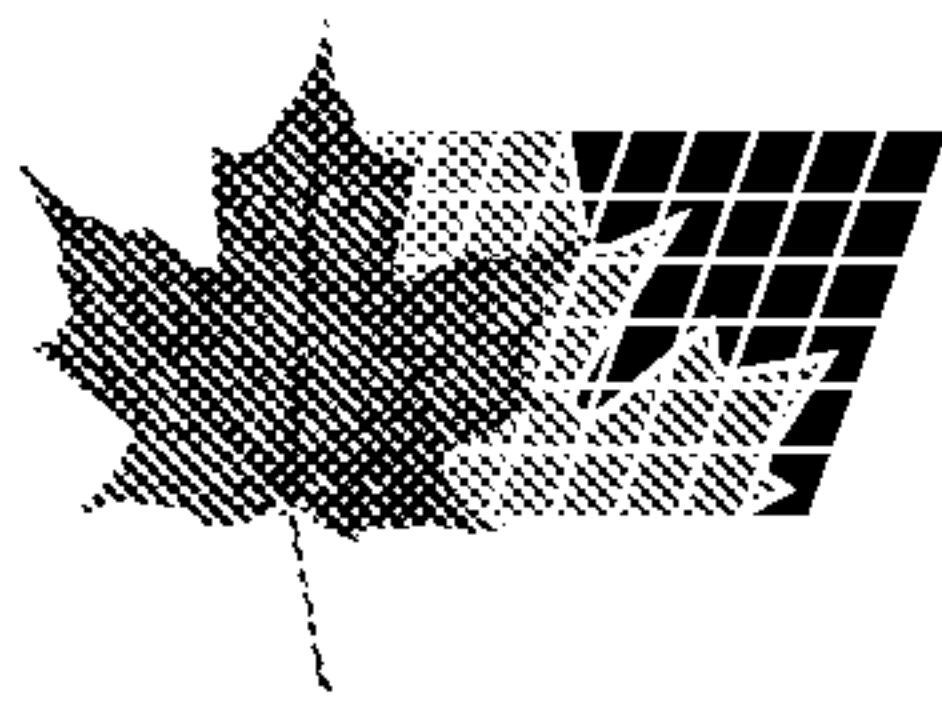
(54) **TRAVERSE DE CHEMIN DE FER, SELLE DE RAIL ET
CRAPAUD DE RAIL AMELIORE**

(54) **IMPROVED RAIL TIE, TIE PLATE AND CLIP**



(57) Socle de rail pour traverse (410, 420, 440, 460, 478) en deux éléments, chacun comportant un épaulement (414) d'appui de la semelle du rail, une aile dirigée vers le bas (421) et un saillant latéral (422), et conçu pour être monté sur la partie plane (21, 121, 221, 321) d'une traverse d'acier percée de fentes, en introduisant le saillant (422) de chacun des éléments dans sa fente respective et en abaissant l'élément vers l'intérieur. Socle de rail (410, 420, 440, 450, 460, 478) muni d'épaulements (414) longitudinaux et comportant une surface d'appui tournée vers le bas, et tel que par des ouvertures (424) pratiquées latéralement dans chacun

(57) A rail tie plate (410, 420, 440, 460, 478) comprises two elements each provided with a rail flange shoulder (414), a downward leg (421) and a lateral projection (422) whereby the tie plate can be installed on a plate member (21, 121, 221, 321) of a slotted steel tie (20, 120, 220, 320) by insertion of the projection (422) of each element into a respective slot and rotation of the element inwardly and downward. A tie plate (410, 420, 440, 450, 460, 478) having longitudinal shoulders (414) is provided with a downwardly facing abutment surface such as provided by an opening (424) laterally through each shoulder



(11) (21) (C) **2,164,115**
(86) 1994/06/02
(87) 1994/12/08
(45) 2000/02/22

des épaulements (414), on puisse engager un crapaud (430, 470, 482, 489) s'appuyant sur l'une des faces supérieures de la semelle du rail (416). Le dévers du rail est contrecarré par le transfert des couples au socle (410, 420, 440, 450, 460, 478), transfert qui résulte de l'engagement du crapaud (430, 470, 482, 489) dans l'épaulement (414) et de la résistance opposée au couple par la liaison socle (410, 420, 440, 450, 460, 478) traverse (20, 120, 220, 320). Traverse d'acier pour voie ferrée comportant une partie plane (21, 121, 221, 321) oblongue se fixant transversalement au rail et une âme (23) ou des âmes (123, 223, 323) verticales s'étendant le long de la partie plane (21, 121, 221, 321) et en retrait par rapport à ses côtés les plus longs. Plaque s'enfonçant dans le ballast (33, 41, 133, 233, 333) pouvant se fixer sous la traverse, en général perpendiculairement au rail, ou extrémités recourbées de la partie plane (21, 121, 221, 321) de la traverse assurant la même fonction.

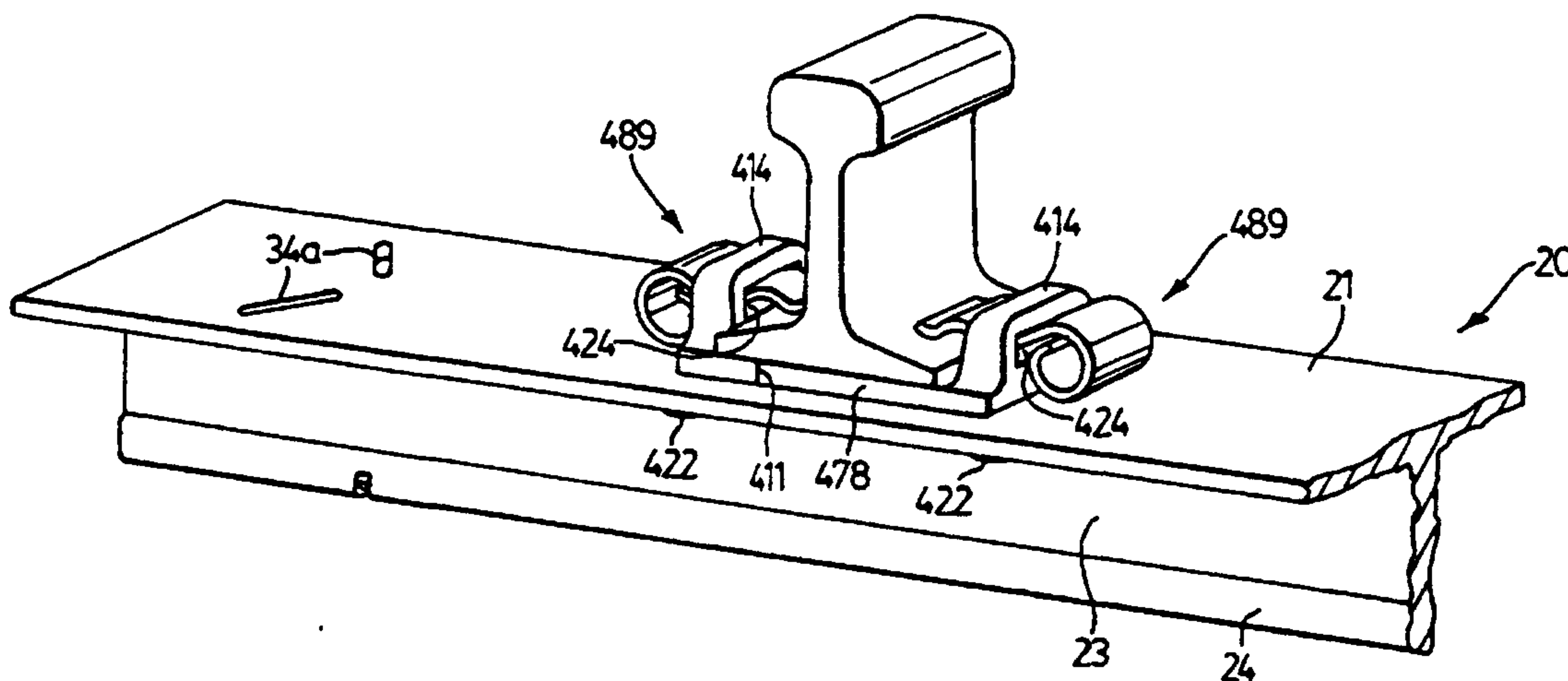
(414) on which a rail clip (430, 470, 482, 489) engages to bear on an upper side of the rail flange (416). Rail rollover is avoided by transferring rotational forces to the plate (410, 420, 440, 450, 460, 478) through the engagement of the clip (430, 470, 482, 489) on the shoulder (414) and resisting such rotational force at the connection between the tie plate (410, 420, 440, 450, 460, 478) and the tie (20, 120, 220, 320). A steel tie for incorporation in a rail track has a horizontal oblong rectangular plate member (21, 121, 221, 321) for connection transversely of the rail, and a web (23) or webs (123, 223, 323) extending vertically on the underside of the plate member (21, 121, 221, 321) and spaced inwardly from its longer sides. A ballast engaging plate member (33, 41, 133, 233, 333) may be connected on the tie on its underside and faces generally transversely of the rail or ends of the plate (21, 121, 221, 321) may be bent downwardly.



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : E01B 3/16, 9/42, 9/48		A1	(11) International Publication Number: WO 94/28245
			(43) International Publication Date: 8 December 1994 (08.12.94)
(21) International Application Number: PCT/CA94/00303		(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KG, KP, KR, KZ, LK, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 2 June 1994 (02.06.94)			
(30) Priority Data: 9311396.7 2 June 1993 (02.06.93) GB 08/139,736 22 October 1993 (22.10.93) US			
(60) Parent Application or Grant (63) Related by Continuation US 08/139,736 (CIP) Filed on 22 October 1993 (22.10.93)		Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	
(71)(72) Applicant and Inventor: IGWEMEZIE, Jude, Odihachukwunma [CA/CA]; Suite 2902, 95 Thorncliffe Park Drive, Toronto, Ontario M4H 1L7 (CA).		2164115	
(74) Agent: RIDOUT & MAYBEE; Suite 2300, 101 Richmond Street West, Toronto, Ontario M5H 2J7 (CA).			

(54) Title: IMPROVED RAIL TIE, TIE PLATE AND CLIP



(57) Abstract

A rail tie plate (410, 420, 440, 460, 478) comprises two elements each provided with a rail flange shoulder (414), a downward leg (421) and a lateral projection (422) whereby the tie plate can be installed on a plate member (21, 121, 221, 321) of a slotted steel tie (20, 120, 220, 320) by insertion of the projection (422) of each element into a respective slot and rotation of the element inwardly and downward. A tie plate (410, 420, 440, 450, 460, 478) having longitudinal shoulders (414) is provided with a downwardly facing abutment surface such as provided by an opening (424) laterally through each shoulder (414) on which a rail clip (430, 470, 482, 489) engages to bear on an upper side of the rail flange (416). Rail rollover is avoided by transferring rotational forces to the plate (410, 420, 440, 450, 460, 478) through the engagement of the clip (430, 470, 482, 489) on the shoulder (414) and resisting such rotational force at the connection between the tie plate (410, 420, 440, 450, 460, 478) and the tie (20, 120, 220, 320). A steel tie for incorporation in a rail track has a horizontal oblong rectangular plate member (21, 121, 221, 321) for connection transversely of the rail, and a web (23) or webs (123, 223, 323) extending vertically on the underside of the plate member (21, 121, 221, 321) and spaced inwardly from its longer sides. A ballast engaging plate member (33, 41, 133, 233, 333) may be connected on the tie on its underside and faces generally transversely of the rail or ends of the plate (21, 121, 221, 321) may be bent downwardly.

- 1 -

Improved Rail Tie, Tie Plate and Clip

The present invention relates in a first aspect to a rail tie plate, in a second aspect to a rail tie clip, and in a third aspect to a rail tie. Preferably, these
5 three components are used together, although each may be used independently of the others.

It is known to provide tie plates between the rails and the ties or sleepers of rail track in order to provide a sacrificial wear surface for the rail. However,
10 known tie plates are not as easy or convenient to install as is desirable. Usually, they require the use of separate fasteners such as bolts or spikes for attaching them to the tie.

According to a first aspect of the present
15 invention there is provided a rail tie plate comprising two elements each provided with at least one downwardly extending leg having a lateral projection for passing through and engaging below a horizontal plate member of a tie for resisting vertical movement, and each element
20 having a longitudinal shoulder for abutment on opposite sides, respectively, of a rail flange for resisting lateral movement of the rail, and inwardly from the shoulder, a plate portion for extending beneath the rail and engaging the plate portion of the other element. Each plate portion
25 may be provided with interengaging formations transmitting lateral load applied to one plate element to the other plate element. With this arrangement, the elements of the tie plate may be applied relatively easily to a horizontal plate member of a tie, usually a steel tie, provided with
30 perforations for receiving the leg and lateral projection without requiring additional fastener elements such as bolts or spikes.

According to a second aspect of the invention there is provided, in combination, a tie plate having

- 2 -

opposing longitudinal edges, longitudinally extending shoulders spaced inwardly from such edges adapted to accommodate a rail flange therebetween, an opening in each shoulder, a resilient rail clip having an end portion
5 extending inwardly through each opening and adapted to bear resiliently on an upper side of the flange for restraining the rail against vertical movement, and a base portion extending outwardly from the opening and adapted to bear on
10 the tie plate or of the rail tie. This combination provides increased stability and greatly reduces or eliminates risk of rail rollover, to which known plate and clip devices have been prone, owing to the clip acting as a first order lever with the upper side of the opening acting
15 as a fulcrum and upward movement of the rail flange being resisted by the reaction of the bearing surface. Further, upward movement of the rail flange may be limited by closure of the spacing between the upper side of the rail flange and the lower edge of the clip and this distance can
20 be made small. As a result rotation of the base of the rail can be transferred to the tie plate which may be anchored at a point spaced a distance laterally from the rail, so that the moment of the force resisting rail rollover is considerably increased. The tie plate
25 preferably is, but need not necessarily be, a modified tie plate in accordance with the above first aspect of the invention.

The invention also provides a resilient tie clip comprising a base having at least one generally laterally
30 facing abutment surface adapted to engage a generally laterally facing abutment surface of a tie plate, for resisting lateral pressure on the clip, an intermediate portion extending upwardly and laterally from the base and adapted to pass through an opening in a tie plate shoulder,
35 and an end portion extending laterally from the intermediate portion and downwardly for lodging resiliently on an upper surface of a rail flange. Such clip is

2164115
- 3 -

advantageously employed in the combination mentioned above.

In a third aspect, the present invention provides a steel tie for incorporation in a rail track, comprising a generally horizontal oblong rectangular plate member for connection transversely of the rail and for restraining vertical rail movement, and web structure extending generally vertically on the underside of the plate member and generally parallel to and spaced inwardly from the longer sides of the plate member and serving to restrain longitudinal rail movement. An end or ends of the plate member may be bent downwardly to provide restraint against lateral tie movement, or, in a preferred form, at least one ballast engaging plate member may be connected to the tie on its underside and facing generally transversely of the rail for restraining lateral tie movement.

With the preferred form of tie of the invention, the elements that provide vertical, longitudinal and lateral restraint respectively have in effect been separated into three distinct elements each of which can be designed substantially independently of the others to provide the required motion restraint and other characteristics. The tie is well adapted to distribute stress and mitigate stress concentrations. A further advantage is that the structure of the tie lends itself readily to conventional stress analysis techniques, for example finite element stress analysis so that the elements and the structure as a whole can be engineered to provide for satisfactory stress management.

With the tie of the invention, the horizontal plate member bears on the ballast and can serve to provide sufficient bearing area to maintain ballast stresses at desired low levels. The web structure can serve to ensure adequate shear stiffness for the tie. Preferably, the web structure comprises one or more webs the lower edge or edges of which is or are thickened or bulbous, since it has

2164115 - 4 -

been found that this reduces stress concentrations in the tie. The bent over end or ends of the plate member, or the ballast engaging plate member or members provide restraint against lateral buckling of the track under compressive or thermal forces, centripetal train forces on curves, partial uplift of track between heavy axles or combinations of these. In the preferred form, the ballast engaging plate member or members are concave on the side facing forwards or adjacent end of the tie to provide increased lateral strength, and have a portion or portions passing upwardly through the horizontal plate member and are located relative to the plate member, for example by bending or twisting the end portions or by using cotter pins or like pins passed through holes in the portions upstanding above the horizontal plate member. A portion of the ballast engaging plate member or members is preferably seated in and located in a notch in a lower edge of a web member. This preferred arrangement provides a simple and highly effective connection between the ballast engaging plate member or members and the tie. The tie may have a ballast engaging plate member adjacent each end and, if the end plate members do not provide sufficient lateral restraint in a given application an intermediate plate may be provided at a point the preferred location of which may desirably be determined with the aid of stress analysis.

The above noted aspects of the invention are described in more detail hereinafter, by way of example, with reference to the accompanying drawings.

Fig. 1 is an isometric view of a first form of tie in accordance with the invention;

Figs. 2 and 3 are plan and side views, respectively, of the tie of Fig. 1;

Fig. 4 is a cross section taken on the line IV-IV in Fig. 3;

- 5 -

Fig. 5 is an isometric view showing rail fastening means of the tie of Figs. 1-3;

Fig. 6 shows the shoulder portions and locking pins for the fastening means of Fig. 5;

5 Fig. 7 shows a cross section on an enlarged scale taken on the line VII-VII in Fig. 3;

Fig. 8 is a longitudinal cross section on an enlarged scale of a modified form of tie having two vertical webs and a ballast engaging plate member in
10 accordance with the invention;

Fig. 9 is an isometric view of a further modified form of tie having two vertical webs in accordance with the invention;

Figs. 10 and 11 are plan and side views,
15 respectively, of a still further modified form of tie having two vertical webs;

Fig. 12 shows a transverse cross section taken on the line XII-XII in Fig. 10; and

Figs. 13, 14 and 15 show longitudinal cross
20 sections taken on the lines XIII-XIII, XIV-XIV and XV-XV, respectively, in Fig. 11.

Fig. 16 is a cross sectional view showing various forms of tie supported on ballast and illustrating the ballast requirements thereof;

25 Fig. 17 is an isometric view of a preferred form of tie plate in accordance with the invention.

Figs. 18 and 19 are isometric views of a further form of plate in unassembled and assembled condition,

2164115 - 6 -

respectively.

Fig. 20 is an end view, partly in section showing successive stages in the application of a plate in accordance with Figs. 18 and 19 to a plate member of a tie.

5 Fig. 21 is an isometric view of a preferred form of clip.

Fig. 22 is an end view partly in section of preferred forms of tie plate and clip applied to a plate member of a tie.

10 Fig. 23 is an end view, partly in section, of a preferred form of plate and clip applied to a wooden tie.

Fig. 24 is a partial side view, partially in section showing a further form of tie plate and clip in accordance with the invention.

15 Figs. 25 and 26 are isometric views of further preferred forms of tie plate in accordance with the invention;

Fig. 27 is a partial view illustrating application of a preferred tie plate to a preferred form of
20 rail tie;

Fig. 28 is an isometric view of a preferred rail tie adapted to receive preferred tie plates;

Fig. 29 is a partial isometric view of a short section of rail engaged by further preferred forms of tie
25 plate and rail clip;

Fig. 30 is an end view partially in section showing a tie having the tie plate and clip of Fig. 29 applied thereto;

- 7 -

Fig. 31 is a partially isometric view showing a tie and tie plate and a further preferred form of tie clip;

Fig. 32 is a partial cross-section through the tie, plate and clip of Fig. 31; and

5 Fig. 33, which appears on the same sheet as Fig. 24, is a side view, partly in section, showing a further modified form of tie plate and clip.

Referring first to the embodiment of the invention shown in Figs. 1 to 7, a steel tie 20 comprises a
10 generally horizontal oblong rectangular plate member 21 which is for connection transversely of the rails of which a short section of one rail is indicated at 22 in Figures 1 and 2. Web structure extends generally vertically on the underside of the plate member 21. In the example of
15 Figures 1 to 7, the web structure comprises a web member 23 extending substantially centrally between the longer sides of the plate member 21. Preferably, in order to alleviate strains to which the tie is subjected in use, the plate member 21 increases in thickness from each longer edge
20 inwardly toward the web member 23. For example, in one preferred form, the lower side 21a of the member 21 slopes inwardly downwardly at an angle of about 2°. The lower side of the member 21 joins with the web member 23 through a smooth arcuate transition portion 21b. Preferably, in
25 order to reduce stresses to which the tie is subjected in use, the lower edge of the web member 23 is formed with a bulbous portion 24, the edges of which merge smoothly with the sides of the web member 23, as best seen in Fig. 7.

In the preferred form of tie shown in the
30 drawings, the horizontal member 21 provides sufficient bearing area to minimize ballast stress. The web member 23 ensures adequate shear stiffness whereas the bulbous portion 24 at the base of the web member 23 carries tensile and compressive stresses arising from bending of the tie.

2164115

- 8 -

To fasten the rails such as rail 22 to the ties, shoulder members 26 are provided. The shoulder members 26 hold the rail 22 with the aid of conventional clip members, for example Universal Pandrol clips 26a as shown. As will be appreciated, however, the structure of the invention is adapted to cooperate with various forms of rail fastening devices. In the example shown in Figs. 1 to 7, a pair of the shoulder members is employed on each side of each rail 22. Each shoulder member 26 has two leg portions that extend through slots formed in the horizontal plate member 21. The leg members 27 anchor beneath the plate member 21 through application of locking pins 28 inserted through openings 29 in each leg member 27. In the preferred form, to provide for desired inward cant of the rails 22, cant plates 31 are employed between the shoulder members 26 and the upper side of the horizontal plate member 21. The plates 31 are provided with slots to receive the leg members 27. It may be noted that cant plates 31 of any desired degree of tilt may be incorporated into the fastening means. For example, some railroads use 1:20 cant plates and others 1:40 cant plates. The tie according to the present invention does not need to be specially deformed to provide for either type of rail seat cant. The cant plates 31 which are sandwiched between the rails 22 and the plate member 21 also serve as sacrificial wear plates that are considerably easier and substantially less expensive to replace than an entire tie. If desired, in order to provide improved distribution of stress through the tie, the cant plates may be crowned in the direction longitudinal of the rails 22. Such crowning of the cant plates is indicated somewhat exaggeratedly and schematically by the broken line 32 in Fig. 7. Such crowning may desirably provide for point contact between the inclined or canted rails 22 and the cant plate 31. Such point loading may improve the distribution of stress and mitigate stress concentrations.

The tie 20 may be provided with at least one
RECTIFIED SHEET (RULE 91)

ISA/EP

- 9 -

ballast engaging plate member such as a member 33 connected to the tie on its underside and facing generally transversely of the rail 22 for restraining lateral tie movements. To provide for added lateral strength, the plates 33 are preferably curved, to provide a concavity on the side facing transversely outwardly towards the end of the tie 20. Each plate member 33 is connected to the tie 20 through a three point securement. The upper end of each plate member 33 is provided with a pair of upwardly extending end portions 34 passing through slots 34a formed symmetrically of the medium of the plate member 21 that extends transversely of the rail, for transferring lateral forces between the portions 34 and the plate member 21. The slots are, accordingly, preferably formed symmetrically on each side of the web member 23. Cotter pins 36 or like retaining pins may be passed through holes 35 in the upper end portions 34 to locate the plate members at each of two upper points adjacent the upper side of the plate member 21. Alternatively, the end portions 34 extending above the plate member 21 may be bent over or twisted to locate them relative to the plate member 21. The third retaining point for each plate member 33 is provided in the examples shown in Figs. 1 to 7 by a notch 37 formed in the lower side of the bulbous portion 24 of the web member 23. Each plate member 33 is formed with a slot in its upper side, as seen in Figure 7, through which the web member 23 extends. A portion 39 of the plate member adjacent the lower end of the slot 38 lodges in the notch 37.

The plates 33 are preferably connected in the ends of the tie 20 at areas where the stresses applied are very low. A further advantage of the present design is that the size of the plates 33 can be increased or decreased at will by substituting differently sized plates for the plates 33 in order to provide greater or smaller ballast-engaging area or to match the required lateral track stability in a given application.

- 10 -

Alternatively, instead of providing separate plates 33, an end or both ends of the plate member 21 may be bent over downwardly to provide restraint against lateral movement. In such case, the end portion or
5 portions of the web member 23 are cut away, and the end or ends of the plate member bent down preferably to abut against the cut ends of the web member 23.

Where the lateral stability provided by the end plates 33 is not sufficient, one or more intermediate
10 ballast-engaging plates 41 may be located in the middle span of the tie 20 to provide extra lateral strength to the tie 20 and to brace the web member 23 against transverse buckling. The exact location of the intermediate plate or plates 41 to avoid undesired stress concentrations may be
15 determined by conventional stress analysis methods. In the example shown, the intermediate plate member 41 is, similarly to the plate members 33, retained by a three point securement wherein cotter pins 42 are passed through holes in upper end portions 43 of the plate member 41
20 upstanding through slots formed through the horizontal plate member 21 on either side of the web 23, and a lower portion of the plate 41 is located in a notch 44 formed in the bulbous portion 24 at the bottom edge of the web 23.

Fig. 8 illustrates a modified form of tie having
25 two vertical web members. Elements similar to the embodiment of Figs. 1 to 7 are indicated by the same reference numerals raised by 100. As seen in the cross section of Fig. 8, which is taken in the direction longitudinally of the rails, the tie 120 has a horizontal
30 plate member 121 provided on its underside with two web members 123 each extending parallel to and inset from the longer sides of the plate 121. It may be noted that a central portion 121c between the webs 123 is somewhat thicker than the edge portions on either side. In this
35 example, a three point connection for the ballast engaging plate member 133 is provided by an upper central portion

- 11 -

134 of the plate 133 passing through a corresponding central slot in the portion 121c, and having an opening 135 through it for receiving a cotter pin or like retaining pin. Notches 137 formed in the lower edge of each web member 123 receive and locate lower end portions of slots 138 formed in the upper side of the plate 133.

With reference to Fig. 9, a further embodiment is shown and reference numerals raised by 200 indicate elements similar to those of the embodiment of Figs. 1 to 7. The tie 220 of this embodiment differs from the embodiment of Fig. 8 chiefly in that the lower ends of the web members 223 are each provided with tensile and compressive stress reducing bulbous portions 224. The ballast engaging plate members 233 are provided with a three point securement similar to that described above with reference to Fig. 8, wherein there is an upper portion 234 located above the plate member 231 by means of a cotter pin or the like passed through an opening in the member 1234, and lower portions of the plate 233 engage in notches formed in the bulbous portions 224 respectively.

Referring to Figs. 10 to 15, this shows still a further embodiment. Elements similar to those of Figs. 1 to 7 are indicated by the same reference numerals raised by 300. The tie 320 of this embodiment differs from that of Fig. 9 chiefly in that the longer edge portions 312d of the horizontal plate member 321 are thickened and taper somewhat inwardly towards the web members 323. As seen in, for example, the cross section of Fig. 14, the profile of the underside of the horizontal plate member 321 curves arcuately smoothly to blend with a planar portion 321e between the thickened portion 321d and the web 323. The portion 321e blends arcuately smoothly with the side of the web 323.

The shoulders 326 have a single leg portion 327 that passes through apertures in the cant plates 331 and in

- 12 -

the horizontal plate member 321. The leg 327 is formed with a laterally extending portion 346 that engages the lower side of the horizontal plate member 321 between the web members 323.

5 In the embodiment of Fig. 9, shoulder members 236 similar to those described above with reference to Figs. 10 to 13 may be used for fastening the cant plates 231 and rails 222 to the tie member 220.

10 As will be appreciated, the tie members described above, whether having a single web member 23 attached to the horizontal plate member 21, or having double web members 123, 223 or 224, are well adapted to be formed from steel stock by, for example, rolling from bar stock.

15 The ties as described above are well adapted to be incorporated in rail track using conventional tie rail and ballast laying techniques.

 Figure 16 shows cross-sections of various forms of tie supported on ballast 51 disposed on a ground or grade surface 52. In the case of a wood tie 53, a minimum
20 depth "d" of ballast 51 is required below the bearing or ballast engaging surface 54. An additional depth of ballast "a" is required to engage the sides 56 and ends of the tie 53 to restrain longitudinal and lateral movements, respectively. Similarly, with a known form of steel tie
25 57, an additional depth of ballast "a" is required above the bearing surface 58 to engage surface 59 resisting longitudinal movement and surfaces above bearing surface 58 resisting lateral movements. With a known trough shape steel tie 61 a smaller additional ballast depth "c" may be
30 required below surface 62 which transmits part of the downward force to the ballast, but there may be difficulties in introducing ballast into the cavity of the trough 61. With the preferred form of tie 20 of the invention it is relatively easy to introduce ballast below

- 13 -

the plate member 21, and the web member 23 and plates 33 resisting longitudinal and lateral movements extend below the bearing surface 21a so that an additional depth of ballast is not required.

5 Fig. 17 shows a tie plate 410 adapted to be formed by conventional rolling and punching processes from sheet steel stock, or by casting and comprising two elements 410a and 410b which in use interengage along a line 411.

10 Figures 18 to 20 show a similar tie plate 420 which is adapted to be formed by conventional rolling processes or by conventional casting processes and comprises two elements 420a and 420b similar to elements 410a and 410b, respectively, except for some differences
15 noted below. As best seen in Figs. 18 and 19, the interengaging portions are similar on each element and comprise a rectangular longitudinally opening recess 412 and an oppositely directed longitudinally extending rectangular tongue 413, the tongue 413 of each element 410a
20 and 410b, or 420a and 420b, fitting snugly into the recess 412 of each other element.

When in the assembled condition shown in Fig. 17 or 19 the plate 410 or 420 has two longitudinally extending shoulders 414 for receiving, as seen in Figs. 22 and 23, a
25 flange 416 of a rail 417 snugly therebetween.

A laterally outer longitudinal edge 418 of each element 410a and 410b or 420a and 420b is formed with longitudinally spaced formations for engaging a plate member 419 of a steel tie. Each formation comprises a
30 downwardly extending leg 421 and a projection 422 extending laterally therefrom. In the preferred form as shown, each projection extends laterally outwardly to facilitate application of the plate elements 410a and 410b, or 420a and 420b, to plate member 419 in the manner indicated in

2164115

- 14 -

Fig. 20. Each element 410a, 410b or 420a, 420b is received in a pair of longitudinally spaced slots formed through the plate member 419 of the steel tie, for example by punching. One slot 423a and 423b of each pair is seen in the cross-section of Fig. 20. The width of each slot 423a and 423b is approximately equal to the thickness of the metal of the legs 421 and projections 422 and its length is approximately the length of each leg 421 and projection 422, so that these latter fit through the slots 423a and 423b with a small clearance. As seen in solid lines in Fig. 20 each element 410a, 410b, or 420a, 420b is applied in an upright position with its projection 422 received in the slots and is rotated inwardly downwardly as seen in successive stages in broken lines in Fig. 20, so that in the installed position the portions 412 and 413 interengage as seen in Fig. 17 and the projections 422 lodge under the plate 419.

Preferably, a tie 20, 120, 220, or 320 as described above with reference to Figs. 1 to 16 is modified by punching slots such as the slots 423a and b through its plate member, so that it is used as plate 419 with the tie plates 410 or 420 as described above. Other forms of steel tie may be used however with less advantage. For example BHP steel ties as available from BHP Rail Products (Canada) Ltd., Vancouver, British Columbia, Canada may be used.

As will be appreciated each edge 418 may have a single leg 421 and projection 422 extending continuously along it or along a portion, for example a central portion, or may have more than two legs 421 each parallel with a projection 422, engaging corresponding slots in the plate 419.

In the installed position, projections 422 resist upward movement of the plate 410 or 420 relative to the plate member 419 of the tie, and the legs 421 resist lateral and longitudinal movement. Lateral stresses

2164115

- 15 -

imposed by a rail flange on one shoulder 414 are transmitted through the interengaging formations 412 and 413, so that the legs 421 on each element 410a and 410b, or 420a and 420b share the lateral loads.

5 As noted above, the plate member 21 of the tie 20 varies continuously in thickness since it tapers from the central web member 23 outwardly to each longer edge. This is highly advantageous since as a result there is a unique position of tie plate such as tie plate 410, relative to
10 the plate member 21, at which the thickness of the plate member 21 matches the height of the legs 421, or, more accurately, the vertical distance between the lower sides of the elements 410a and 410b and the upper sides of the projections 422. Therefore, when installed, the tie plate
15 such as plate 410 tends to adopt this unique or equilibrium position and the arrangement increases the stability of the location of the plate 410 relative to the tie 20 against movement in the direction extending longitudinally of the rail 417.

20 In the example shown in Fig. 17 each shoulder 414 is formed with a longitudinally horizontally elongated opening 424 for receiving a rail clip as described in more detail later with reference to Figs. 21 to 23.

 The tie plates 420 of Figs. 18 to 20, however,
25 have channel-like longitudinally extending recesses 414a which can receive a limb of a conventional rail clip such as a PANDROL (trademark) rail clip for retaining a rail flange such as flange 416 on the plate 420.

 It may be noted that between the shoulders 414,
30 each plate 410 or 420 provides a planar upper side 426 which preferably is inclined or canted in the lateral direction relative to a planar lower side 427, to provide for desired inward cant of the rails 417.

Figure 21 shows a rail clip 430 having a longitudinally elongated generally rectangular base portion 428 with a planar lower side 429. Each end is formed with a downwardly extending tab 431 which is spaced inwardly from a laterally outer side edge 432 of the base 428. An intermediate portion 433 inclines laterally inwardly and upwardly from the base 428 to a transition portion 434 curving downwardly to provide a convex upper side and an end portion 436 curving upwardly to provide a convex lower side 437.

Figure 22 shows a two part tie plate 440 similar to that described above in detail with reference to Figs. 17 to 20 and installable on a tie 419 formed with slots therethrough in the same manner as described above with reference to Fig. 20. The elements 440a and 440b in this case are preferably formed by casting.

Each shoulder 414 provides a box-form abutment portion and is formed with a horizontally longitudinally elongated slot or opening 424 through it that is bounded by a continuous upper wall providing a downwardly facing abutment surface. Each slot 424 preferably tapers in width in the laterally inward direction, as seen in side view in Fig. 22, so as to provide a lower upwardly laterally inclining ramp portion, to facilitate inward driving of the end portion 436 of a clip 430 as described above with reference to Fig. 21. At this point it may be noted that, in the embodiment of Fig. 17, the slot opening 424 formed through each shoulder 414 tapers in width inwardly again with the object of facilitating or guiding inward movement of the end 436 of a clip 430.

In Figs. 17 and 22, the plate 410 or 440 includes planar web members 441 extending laterally between the shoulders 414 and the longitudinal edges 418 that are punched or otherwise formed with a pair of pits or openings 442 spaced apart longitudinally to receive the spaced tabs 431 of the clip 430.

In use, after installation of the plates 410 or 440 on a tie such as ties 20, 120, 220 or 320 and after

- 17 -

laying of rail 417 on the plates, the end portions 436 of the clips 430 are introduced through the openings 424 and are driven inwardly for example by pressure or blows applied on the outer edge 432 to the installed position
5 seen in Fig. 22 wherein the tabs 431 snap into the openings 442 and the lower side of the end portion 436 of the clip 430 bears on the upper side of the rail flange 416. Preferably each opening 424 has its length approximately the same as the width of the portion 433 of the clip 430 so
10 that the clip 430 lodges in the tie plate 410 or 440 with little longitudinal play or clearance.

In the installed position as seen in Fig. 22, the transition and end portions 434 and 436 are deformed upwardly relative to the intermediate portion 433, the
15 upper side of which bears on the upper side of the opening 414. The line or area of contact between the side of the opening 414 and the clip portion 433 acts as a fulcrum with the result there is a resilient reaction tending to urge the transition and end portions 434 and 436 firmly
20 downwardly to engage the said flange and to urge the base portion 428 downwardly, resulting in the snapping of the tabs 431 into the openings 442 as the clip 430 is driven inwardly. In use, tabs 431 serve as abutment members the lateral flanks of which provide oppositely and laterally
25 facing abutment surfaces engaging the opposing laterally facing sides of the openings 442 and serving to resist lateral displacement of the clips 430 relative to the tie plate 440.

In the event of a reaction applied to the rail
30 417 tending to rotate it about its longitudinal axis, rotation of the rail is limited by the laterally outer end or toe of the rail flange A engaging the underside B of the intermediate portion 433 of the clip 433. Further upward reaction is transferred direct to the shoulder 414, upward
35 movement of which is resisted by projection 422 engaging the plate 419 of the tie member. As a result there is a

2164115

- 18 -

large moment or torque resisting rotation of the rail 417, the length of the arm of which torque is substantially the distance between the projection 422 and the shoulder 414.

Further, even in the event that the transition
5 and end portions 434 and 436 are stressed beyond their elastic limit and become deformed so that they no longer bear resiliently on the flange 416, the clips 430 are retained positively on the plate 410 or 440 as a result of the reaction between the clip portion 433 and the opening
10 414 tending to urge the tabs 431 downwardly into the openings 442, so that the clips 430 will continue to resist rail rollover in the manner described above.

Fig. 23 shows a further example of a tie plate 450, similar to the plate 440 except it is formed as a
15 single piece, for example by casting, suitable for installation on a concrete or wooden tie. In this case, the web members 441 extend a distance beyond the openings 442 and each are provided with openings 443 through which anchor members 444 may pass. Each web member 441 may have
20 a set of, for example, two or three openings 443 spaced longitudinally along the member 441, for receiving conventional fasteners. Such fasteners may be spike members 446, for example, driven into a wooden tie or sleeper 447. The openings 443 may also receive studs or
25 other conventional cast in place anchors of a concrete tie, for example.

As will be appreciated, the one piece tie plate 450 in combination with the clips 430 tends to resist rail rollover by limiting rotation of the toe A of the rail
30 flange and transferring such rotational forces to the plate 450, so that the forces are resisted by the large moment applied by the spike 446 or other fastener spaced laterally outwardly a considerable distance from the toe A.

Fig. 24 shows a partial view of a further form of

- 19 -

tie plate 460 and clip 470. The tie plate 460 is adapted to be formed by casting. Laterally outwards of each shoulder 414, the plate 460 is formed with a reaction shoulder 461, on the upper side of which the base portion 5 471 of the clip 470 rests. The shoulder 461 may extend longitudinally a distance somewhat greater than the width of the base portion 461. In this example the upper side of the reaction shoulder 461 is formed with one or more upstanding studs 462 which are preferably circular in 10 section and snap into holes 472 formed in the clip 470 when the clip 470 is driven inward through the opening 424 to bear on the upper side of the rail flange 416, thereby providing abutment members and openings providing co-operating lateral abutment surfaces resisting displacement 15 of the clip 470 under lateral pressure.

The opening 424 in the shoulder in this example does not taper in width but has parallel upper and lower sides 424a and 424b.

The plate form clip 470 has an upswept 20 intermediate portion 473 which in the installed position is deformed resiliently and bears on the upper side 424a of the opening while a downswept end portion 474 is deformed resiliently and bears resiliently on the upper side of the rail flange 416.

25 As before, rotation of the toe A of the rail 417 is transferred by the clip 470 to the plate 460. The line on which the portion 473 of the clip 470 bears on the shoulder 414 in this case is inside the opening 424 intermediate its ends with the result that the bearing area 30 increases with the loading applied to the clip 470 by the rail 417.

As will be appreciated the plate 460 may be a two-part plate similar to those described above with reference to Figs. 17 to 20 and 22 or may be a one-piece

2164115

- 20 -

plate as described above with reference to Fig. 23.

Fig. 25 shows a modification of the tie plate 460 formed as a two-part plate having elements 460a and 460b which unite along a line 411 inclining, for example at 45°, to the longitudinal direction of the rail. As best seen in Fig. 27, each element 460a and b has a rectangular stud 476 on its underside which engages in a corresponding rectangular opening 477 punched in the plate member 21 of tie 20 on installation in order to increase the stability of location of the plate 460 relative to the tie 20, and especially resisting lateral forces. It may be noted the tie 20 in Fig. 27 is modified in that it has a planar lower face 24a on the bulbous or thickened portion 24.

Fig. 26 shows a further modified two part tie plate 478, wherein each shoulder 414 is at a lateral edge of the respective element 478a or b for use with a tie clip engaging directly with the tie, such as a tie 20, as seen in Figs. 28 to 31. Further, the elements 478a and b are formed with locating and force-resisting studs 479, circular in this example, which are of different sizes, and at each rail position on plate member 21 there is a pair of corresponding differently sized openings 481, so that the tie plates 478 can be installed only in a given orientation, usually with each canted surface 426 facing inwardly of the rail track, with a view to avoiding misinstallation.

Figs. 29 and 30 show the use of the tie plate 478 with a resilient steel plate form tie clip 482 having a base portion 483 engaging the upper side of the plate member 21, and an intermediate portion 484 curving downwardly and inwardly to an upswept end portion 486. Inwardly from the base portion 483, the clip includes an inwardly and downwardly inclining locking portion 487 which in the installed position as seen in Fig. 30 snaps into an opening or pocket 488 formed in the upper side of the plate

- 21 -

member 21. In installation, the end portion 486 is inserted loosely manually into the opening 424 and the rear of the intermediate portion 484 is given blows with a driving tool such as a hammer or slug to drive clip 482 inwardly toward the position shown in Fig. 30. As the end portion 486 is urged upwardly as it rides on the upwardly inclining surface of the rail flange 416, and the intermediate portion 484 is compressed more strongly as it progressively enters the opening 424, there is a strong downwardly compressive reaction at the base 483 and locking portion 487, so that the latter snaps into the pocket 488 when it reaches the installed position. The clip 482 can be removed if desired by levering upwardly on the clip between the base portion 483 and locking portion 487 using a bar like tool.

Referring to Figs. 31 to 32, a plate-form resilient tie clip 489 is used together with tie plate 478. The clip has a spiral-section portion 491 of which a bight or base portion 492 engages the plate member 21 of the tie 20 or other steel tie having a generally planar upper member. The clip 489 has an upwardly concave intermediate portion and a downwardly and then upwardly inwardly swept end portion 494. In installation, the end portion 494 is inserted loosely in the opening 424 and the clip 489 is driven inwardly with blows from a hammer or like driving tool. As the downwardly swept portion 494a enters the opening 424 there is a strong compressive reaction with the upper side of the opening 424, so that as the clip 489 is driven inwards it snaps to the installed position wherein the concave portion 493 is received in the opening 424. The clip 489 is flexed strongly resiliently by the compressive forces acting at the lines of contact between the upper side of the opening 424 and the upwardly concave portion 493 and there is a strong compressive reaction between the base portion 492 and the plate member 21.

It may be noted that in the event of upward

2164115

- 22 -

rotation of the toe A of the rail flange 416, the clip 489 functions as a first class or first order lever wherein the clip 489 pivots about its point or area of contact with the upper side of the opening 424 which acts as a fulcrum, so
5 that the upward force exerted by the toe A on the end portion 494 is counterbalanced by the upward reaction of the plate member 21 on the base portion. The same first order lever action also occurs with the clips 430 of Figs. 21 to 23, 470 of Fig. 24 and 482 of Figs. 29 and 30,
10 wherein the area of contact between the clip and the upper side of the opening 424 acts as a fulcrum. The stresses exerted on the clip in this first order lever action can be made much less than are possible with second or third order lever arrangements as occur with known rail tie clips.

15 In a further modification, instead of having a clip such as the clip 430, 470, 482 or 489 pass through an opening, such as the opening 424, in the shoulder such as shoulder 414, of the tie plate as in the embodiments shown in Figs. 17 and 22 to 32, the shoulder, as seen in Figure
20 33, may be formed to be generally T-shape, as indicated at 414a as viewed laterally from the side of the tie plate 440a, with the upright of the T connected to the tie plate. The end portion of the clip 430a that engages on the rail flange is in such case formed with a slot extending
25 longitudinally inwardly from the end of the clip 430a, so that, when the clip 430a is driven inwardly, the upright of the T 414a enters progressively into the slot, and the upper side of the clip on either side of the slot engages on the underside of the adjacent horizontal limb of the T
30 in the same manner that the above mentioned clips engage on the upper side of the opening 414.

The T members 414a need not be disposed laterally opposite one another centrally of the plate 440a and may be longitudinally offset from one another. Similarly, the
35 openings 424 in the embodiments of Figs. 17 and 22 to 32 may be longitudinally offset from one another along the tie

- 23 -

plate, and the shoulder portions 414 may be of a length somewhat less than the length of the tie plate.

CLAIMS:

1. A steel tie for incorporation in a rail track, comprising:
a generally horizontal oblong rectangular plate member for connection transversely of the rail and having:
a lower surface for bearing on ballast and for restraining vertical rail movement;
and a web member extending generally vertically on the underside of the plate member and generally parallel to and spaced inwardly from the longer sides of the plate member; and wherein the web member has a free lower end adapted to be embedded in ballast and serving to restrain longitudinal rail movement.
2. A tie according to claim 1 wherein the web member extends substantially centrally of the horizontal plate member.
3. A tie according to claim 1 or 2 having at least one ballast engaging plate member connected to the tie on its underside and facing generally transversely of the rail for restraining lateral tie movement.
4. A tie according to claim 3 having a ballast engaging plate member adjacent each end of the tie.
5. A tie according to claim 3 or 4 wherein at least one ballast engaging plate member is curved to provide a concavity on the side facing transversely outwardly towards the end of the tie.
6. A tie according to any one of claims 3 to 5 having a ballast engaging plate member at an intermediate region of the tie.
7. A tie according to any one of claims 3 to 6 wherein

the or each ballast engaging plate member is separately formed from the rectangular plate member and web member and is connected to the tie on its underside and is detachably connected to said tie.

8. A tie according to any one of claims 3 to 7 wherein the or each ballast engaging plate member has at least one upper end portion passing through an opening in the horizontal plate member.

9. A tie according to claim 8 wherein the upper end portion is provided with means adapted to resist withdrawal of the upper end portion from said opening.

10. A tie according to any one of claims 3 to 9 wherein the web member extends through a slot in the upper side of the or each ballast engaging plate member.

11. A tie according to claim 10 wherein the lower edge of the web member is notched adjacent the or each ballast engaging plate member and a portion of the ballast engaging plate member adjacent the lower end of the slot lodges in the notch.

12. A tie according to any one of claims 1 to 11 wherein the lower end portion of the web member is of increased thickness as compared with an upper portion of the web.

13. A tie according to claim 12 wherein the web member has a bulbous lower edge.

14. A tie according to any one of claims 1 to 13 in combination with means for fastening a rail relative to the horizontal plate member comprising a pair of shoulder members for abutting opposite sides of the rail respectively, and each shoulder member having at least

one hook-in leg for passing through an aperture in the horizontal plate member of the tie and for engaging with the lower side of the horizontal plate member.

15. A tie according to claim 14 wherein each hook-in leg has a laterally extending portion for engaging the lower side of the horizontal plate member.

16. A tie according to claim 14 or 15 wherein each shoulder member has an abutment portion upstanding therefrom having an opening therethrough providing a downwardly facing abutment surface for reaction with a rail clip.

17. A tie according to claim 16 wherein said abutment portion is box-form and said opening therethrough is bounded by a continuous upper wall providing said downwardly facing abutment surface.

18. A tie according to claim 16 or 17 wherein a lower side of said opening comprises an upwardly laterally inwardly inclining ramp portion.

19. A tie according to any one of claims 16 to 18 wherein each shoulder member has a seating portion extending laterally outwardly from the abutment portion and having a lower side bearing on the plate member and an upper side formed with a pit for locating a rail clip.

RIDOUT & MAYBEE
Toronto, Canada

Patent Agents

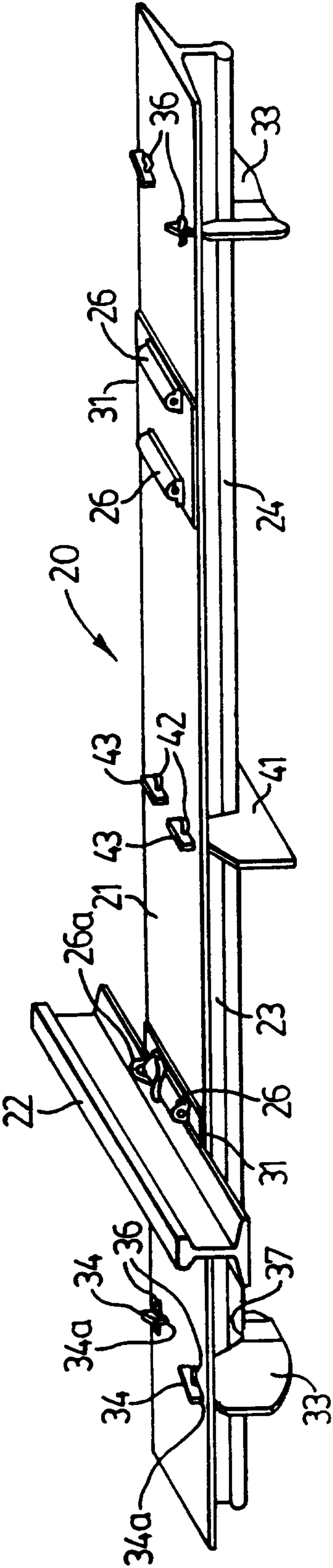
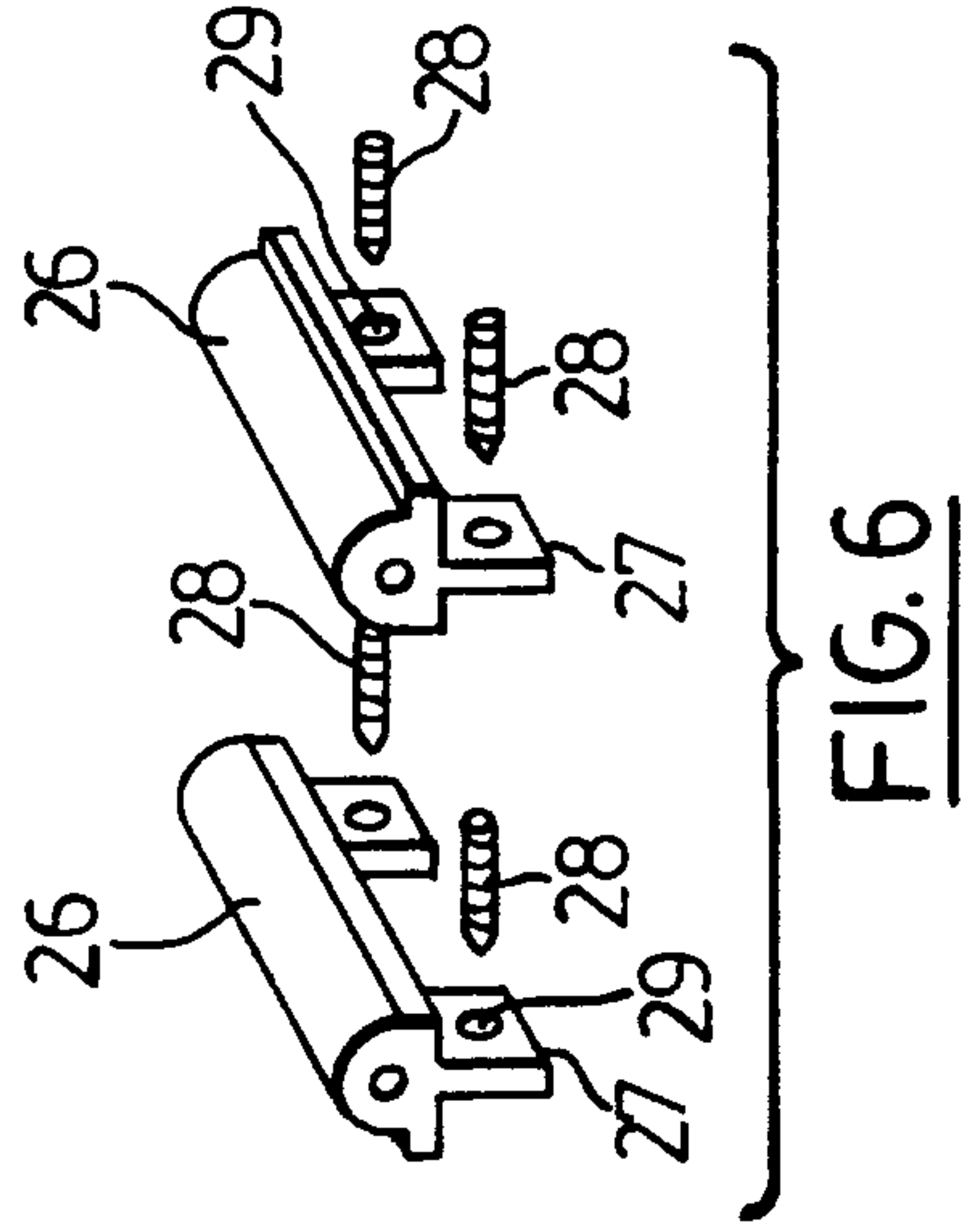
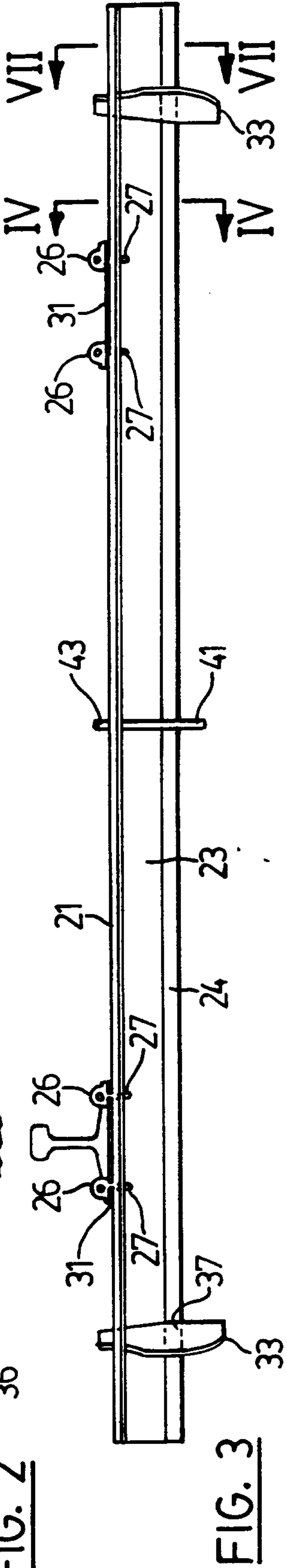
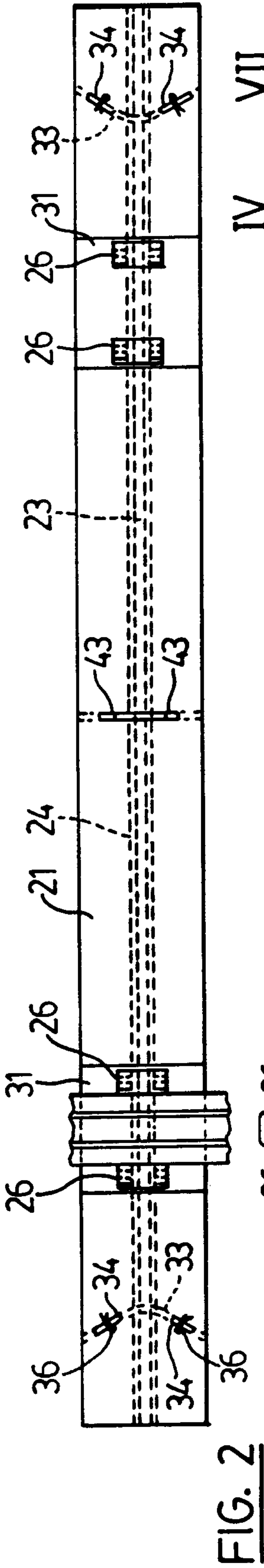


FIG. 1



2164115

3/15

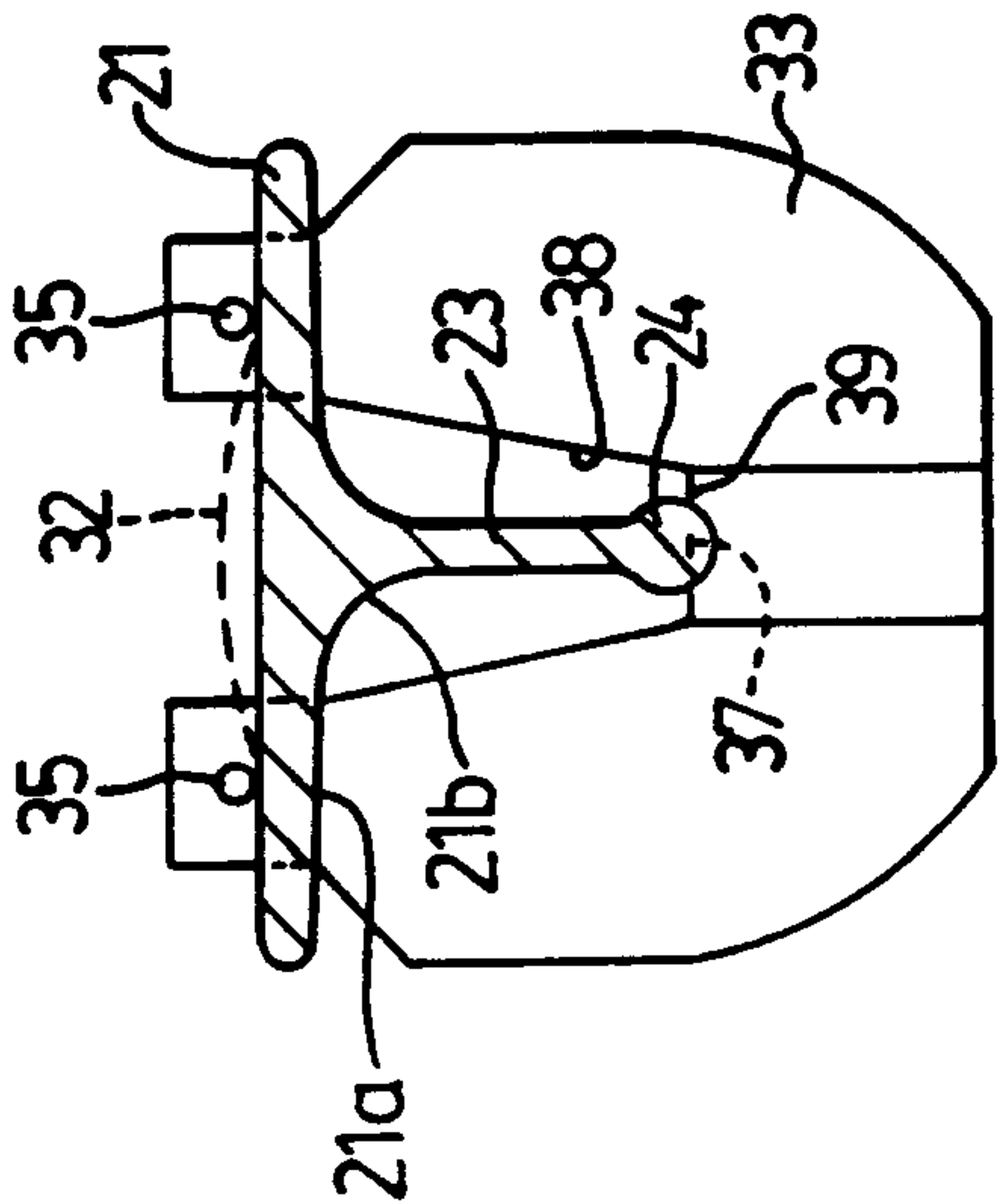


FIG. 7

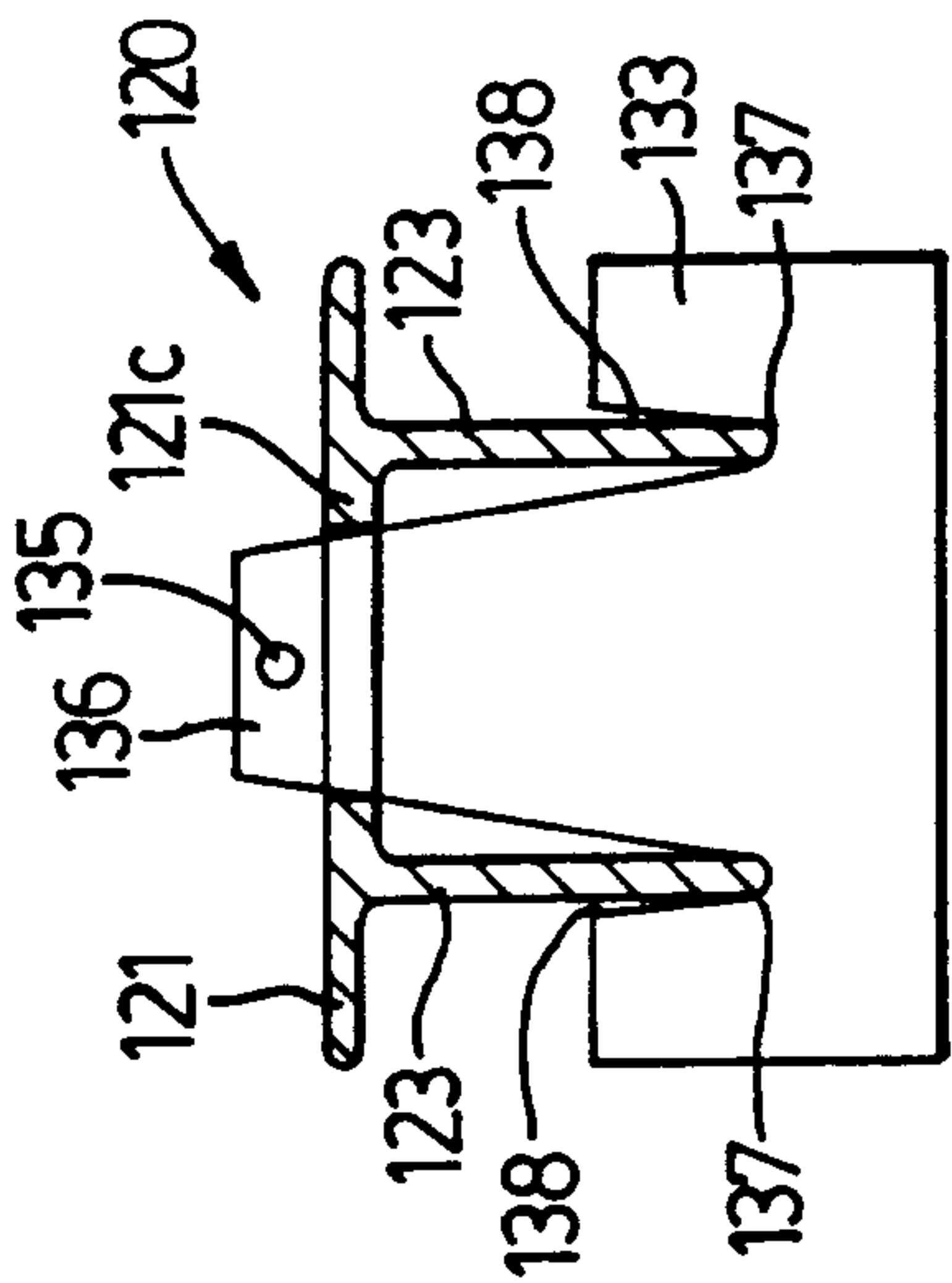


FIG. 8

2164115

4/15

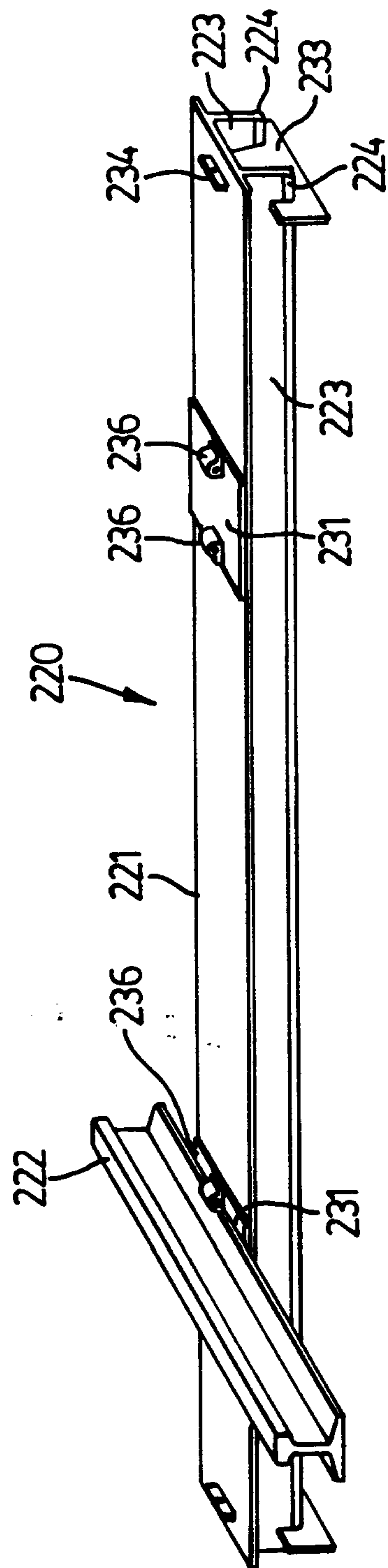


FIG. 9

2164115

5/15

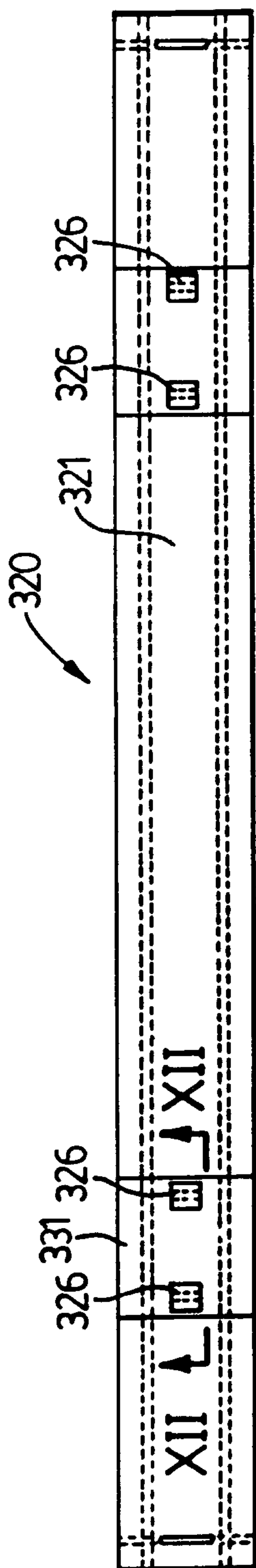


FIG. 10

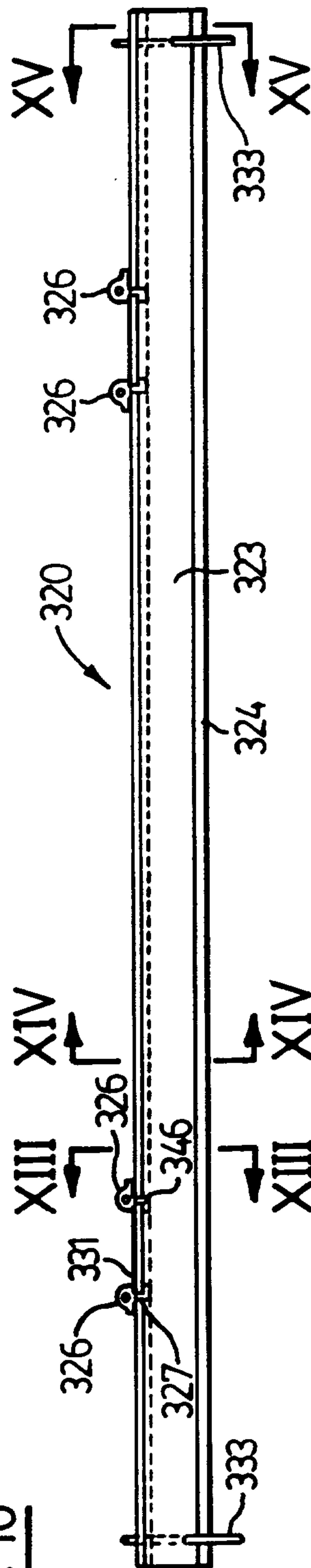


FIG. 11

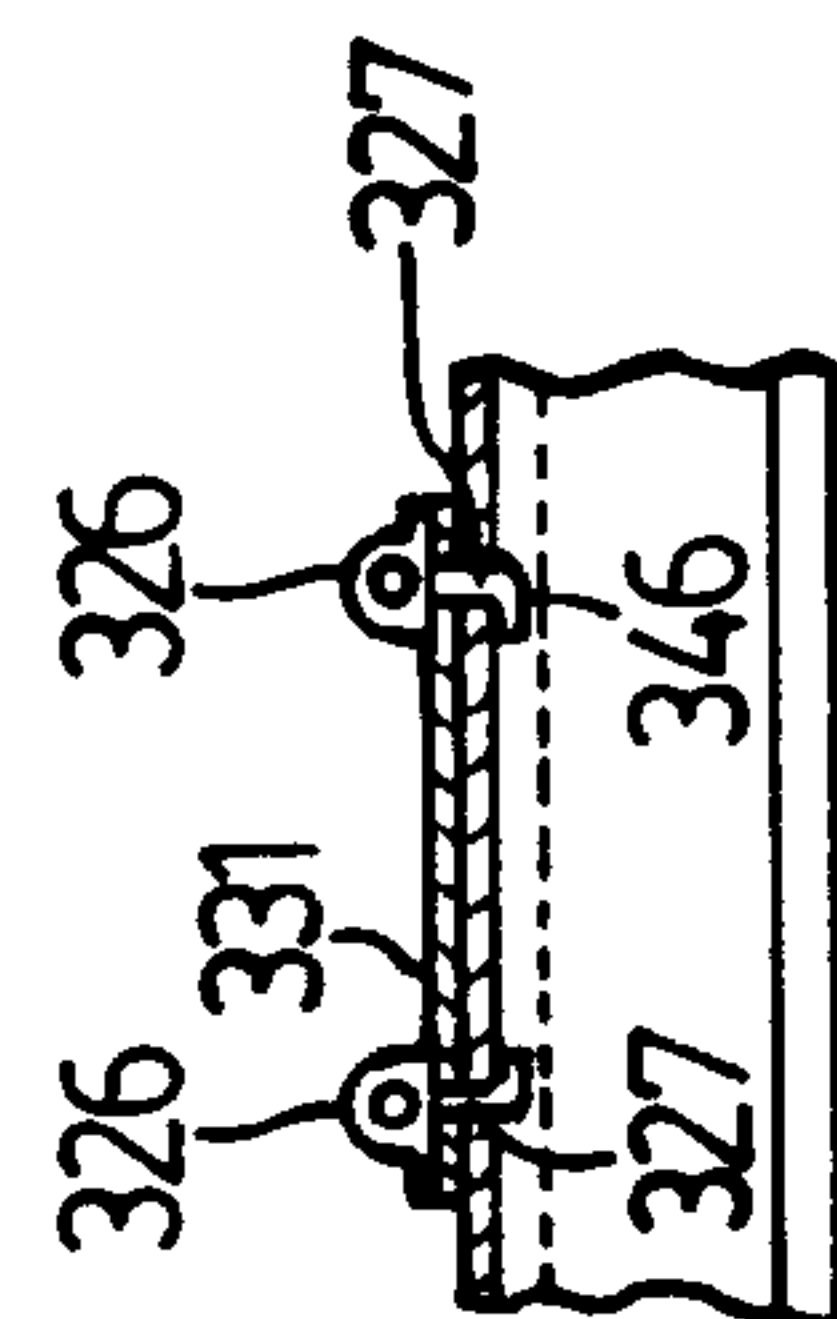


FIG. 12

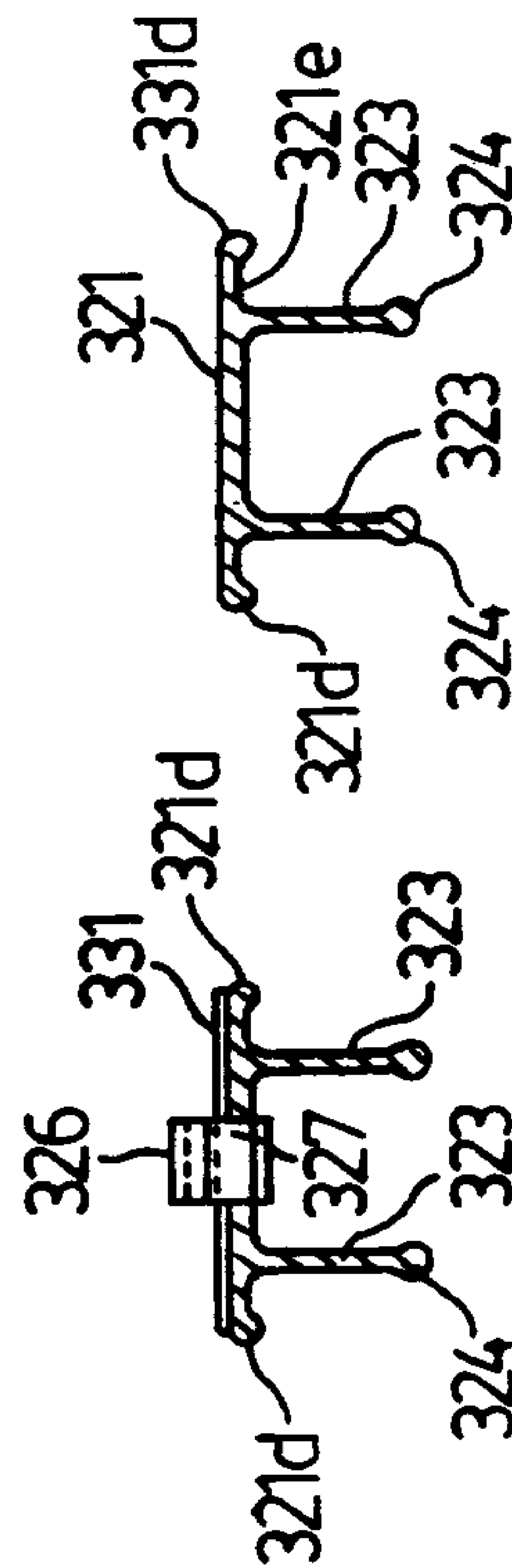


FIG. 13

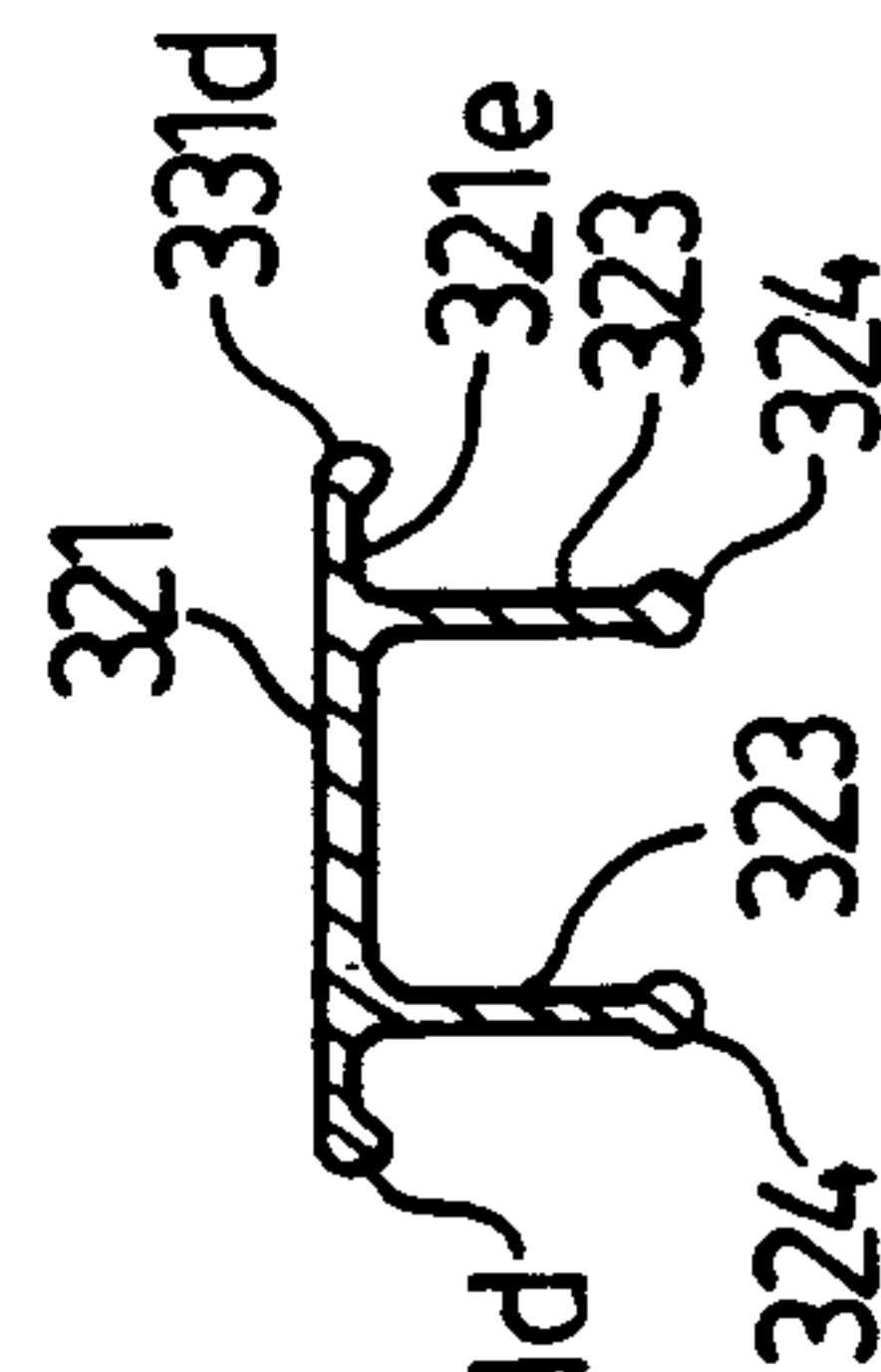


FIG. 14

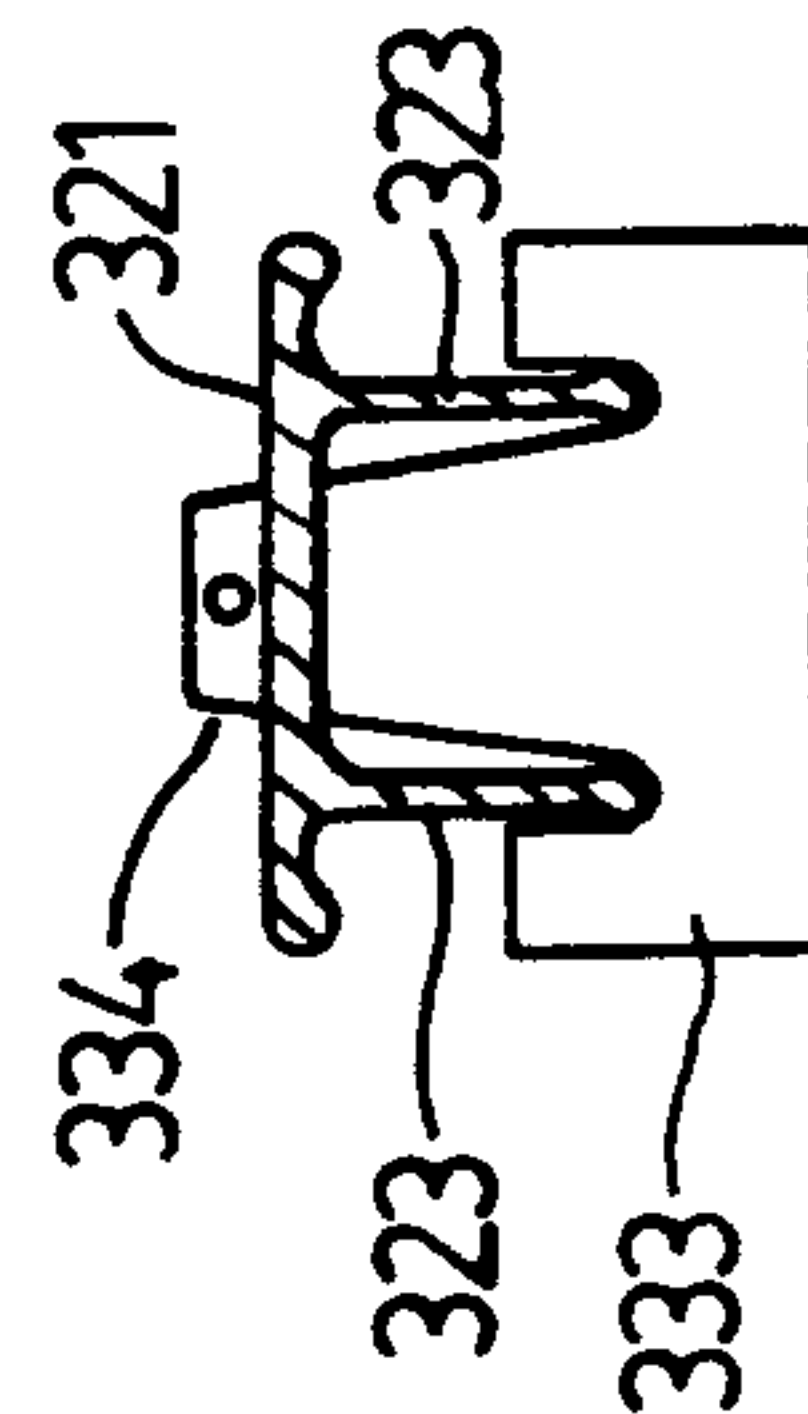


FIG. 15

SUBSTITUTE SHEET

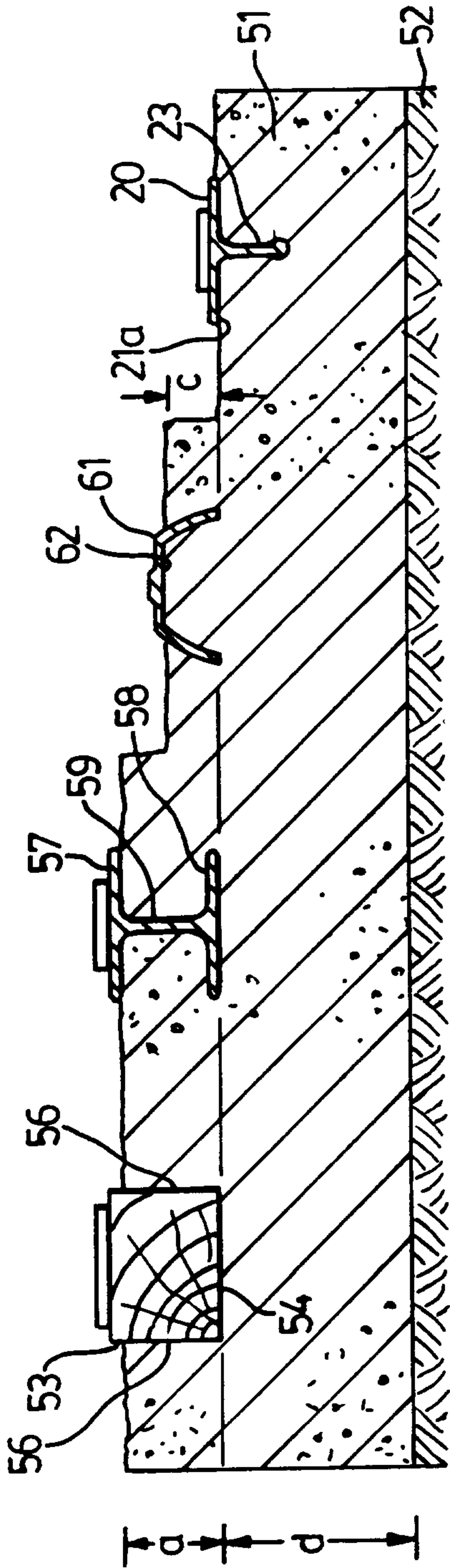


FIG. 16

2164115

7/15

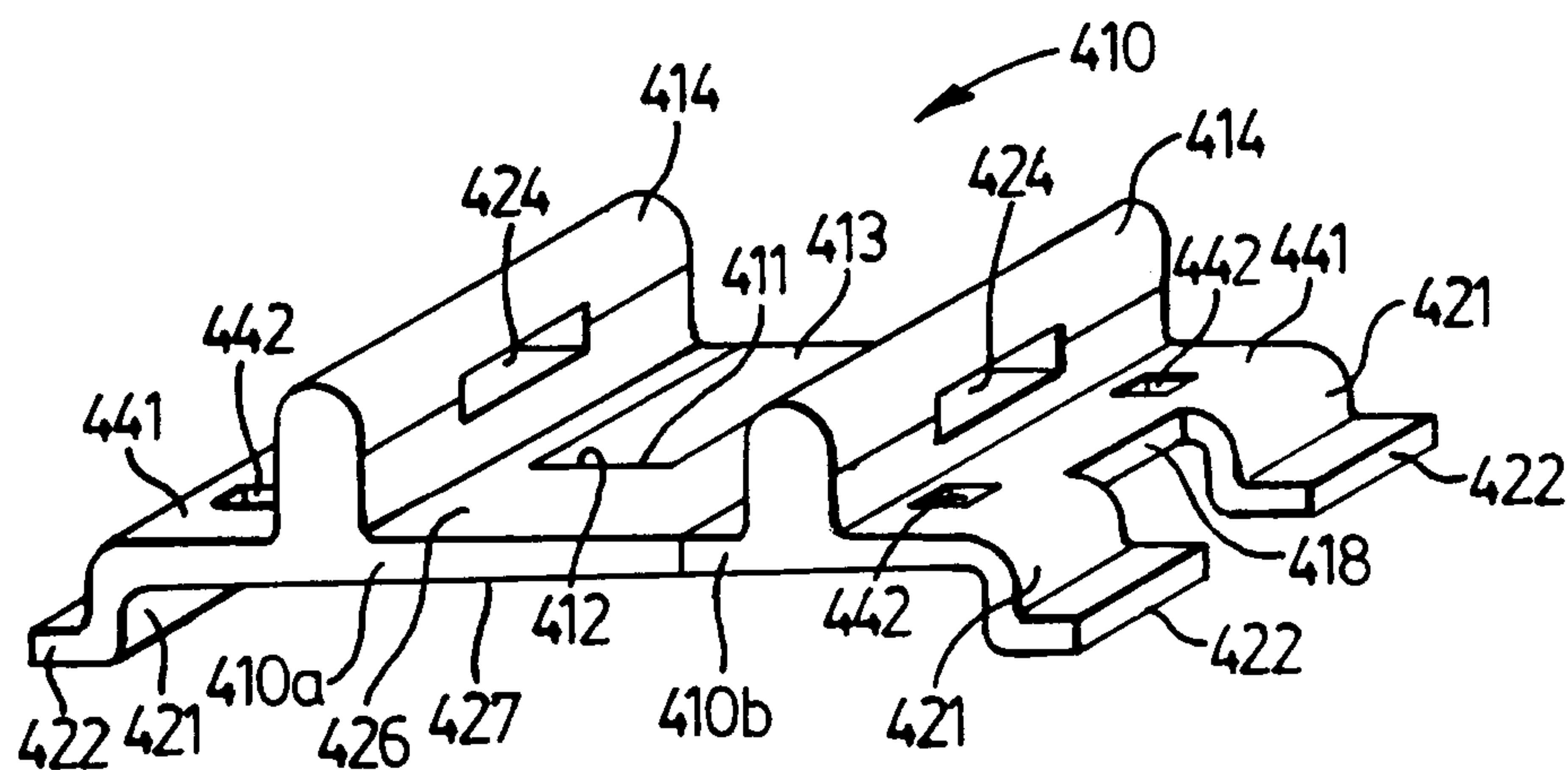


FIG. 17

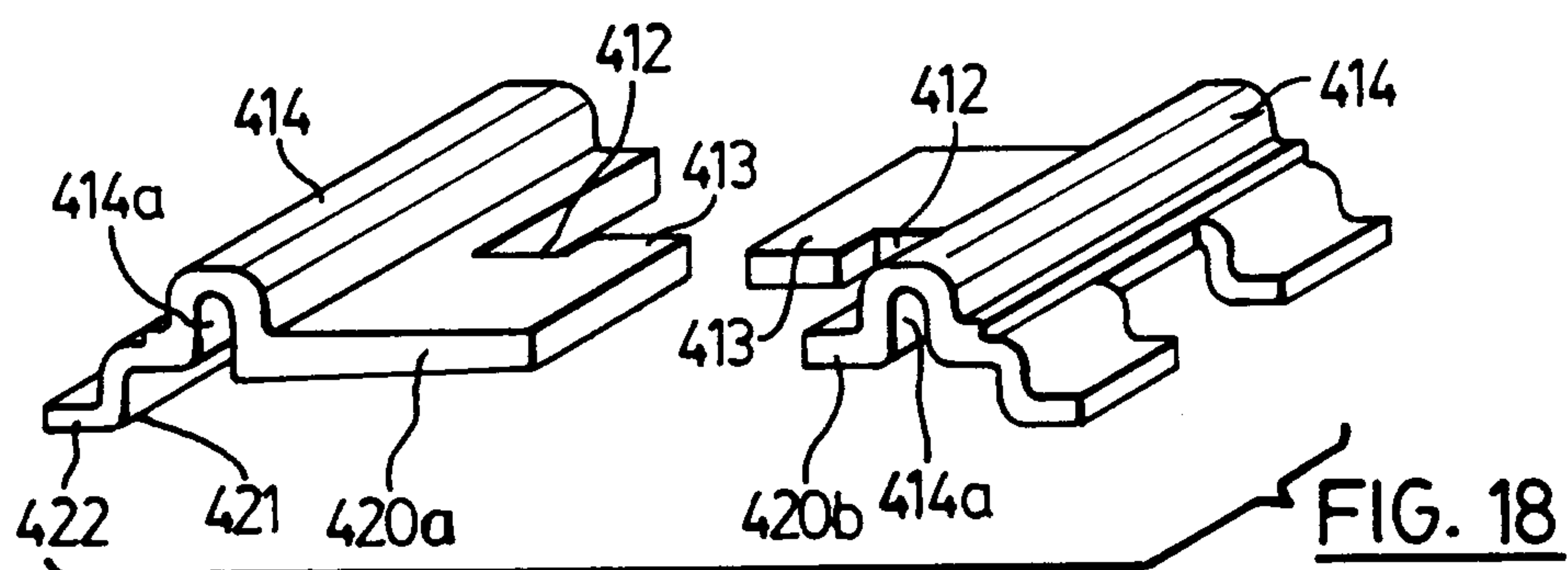


FIG. 18

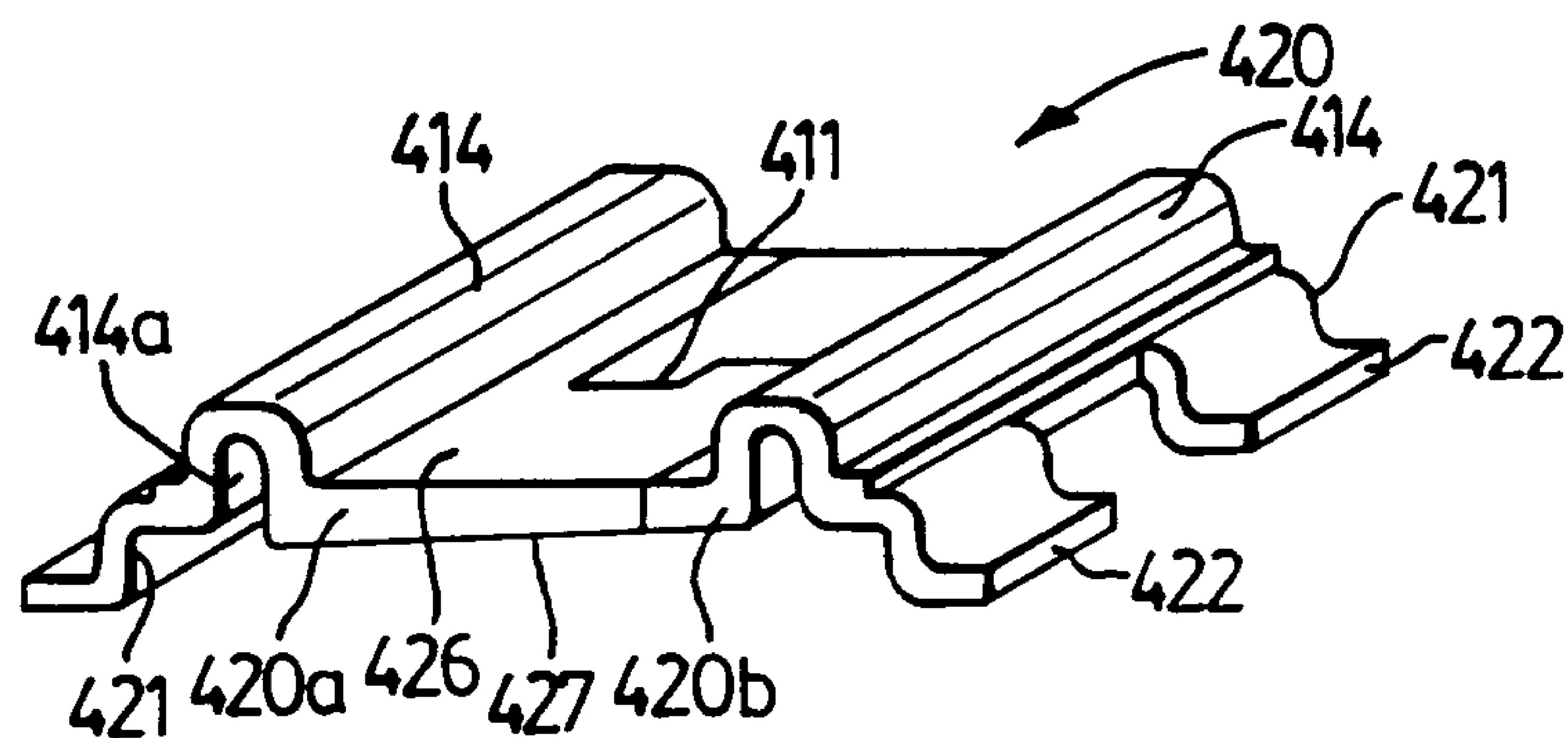


FIG. 19

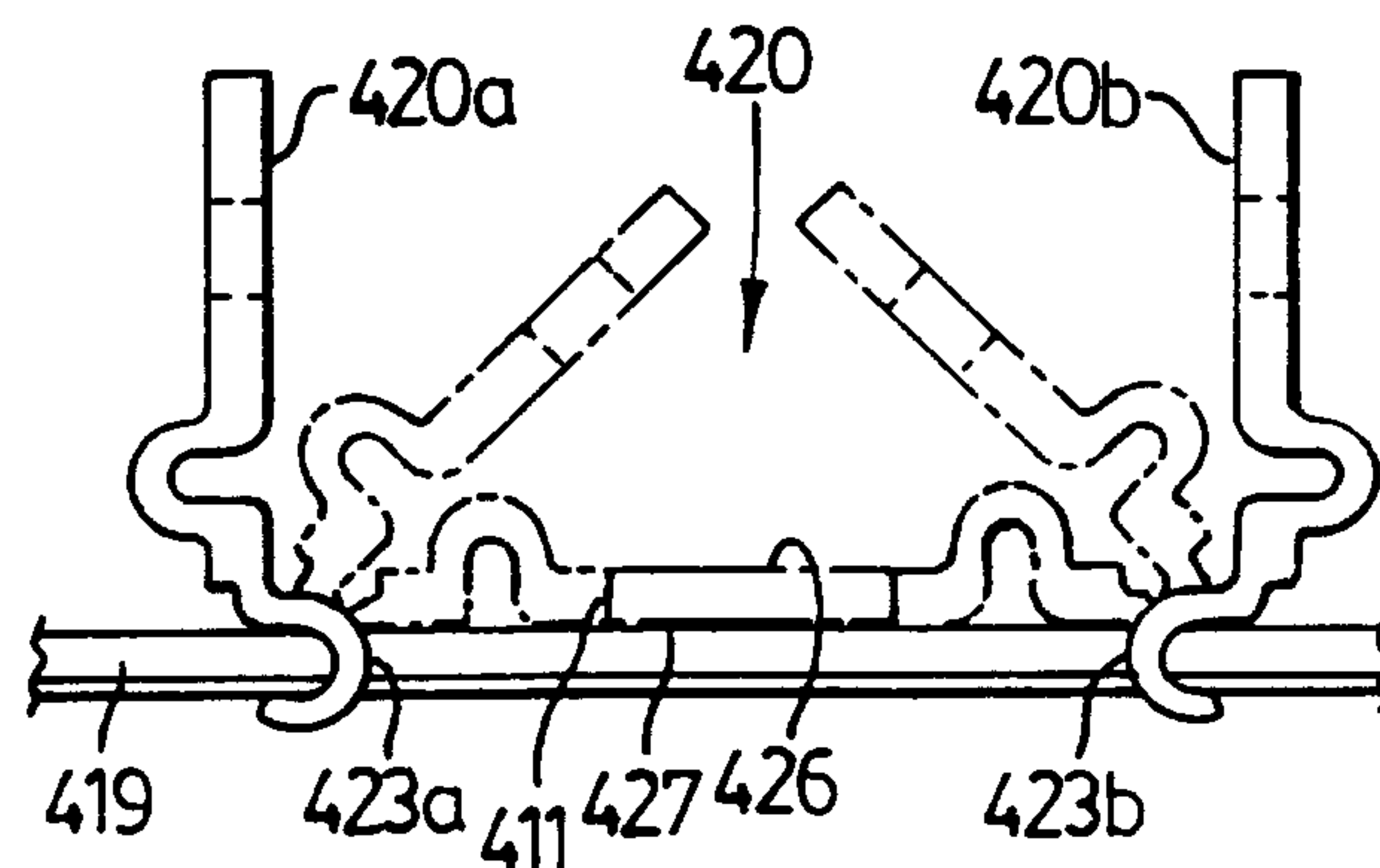


FIG. 20

SUBSTITUTE SHEET

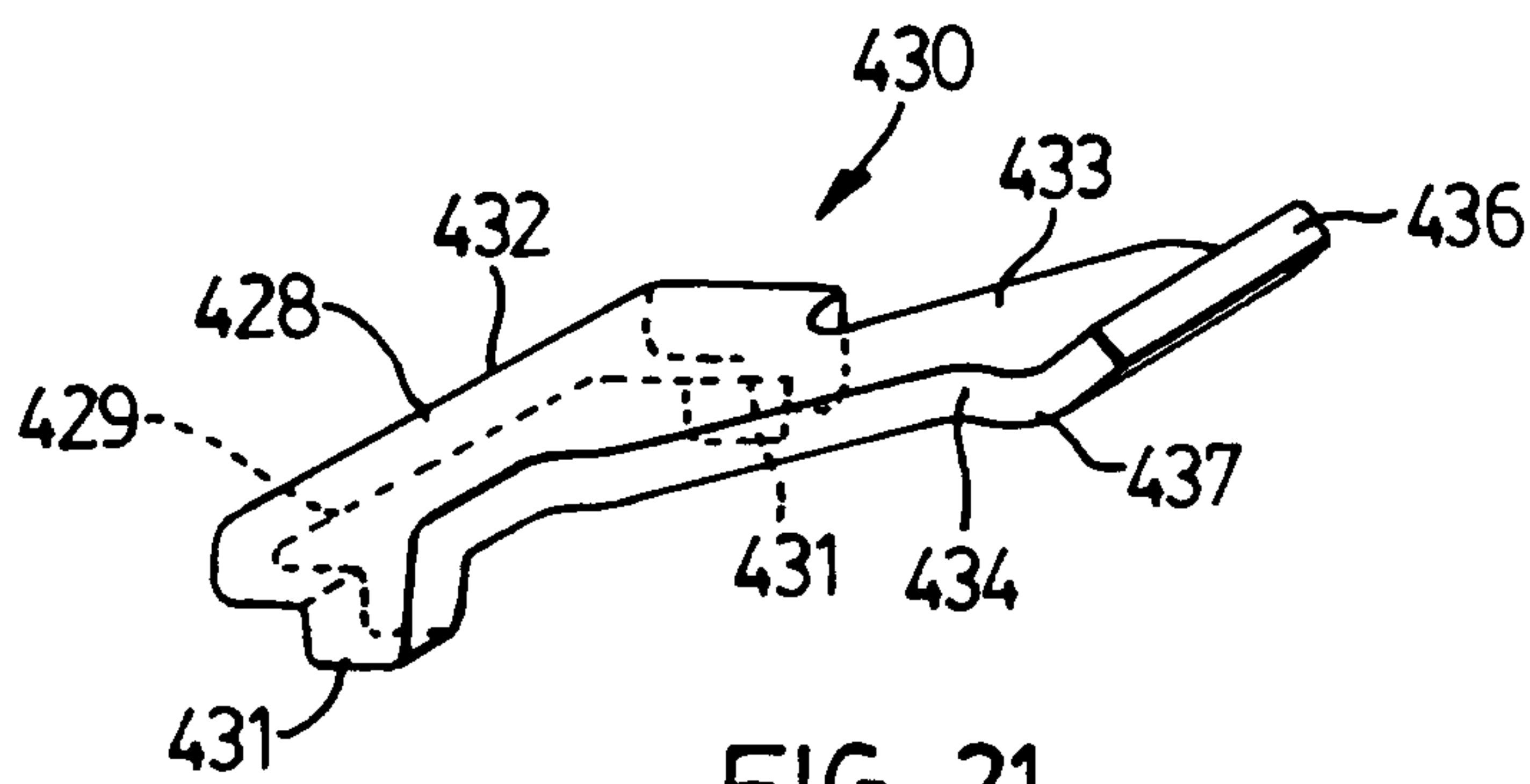


FIG. 21

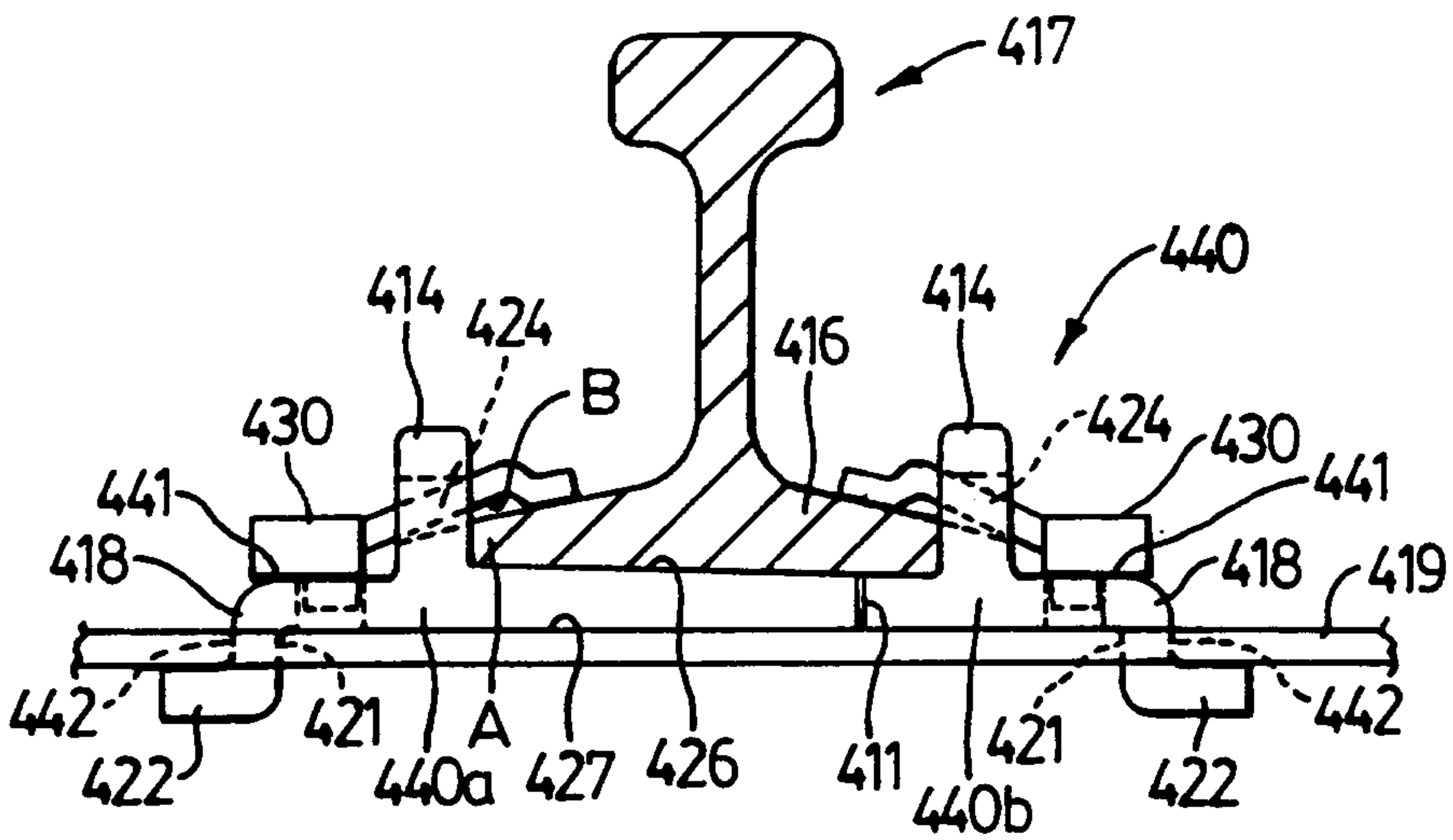


FIG. 22

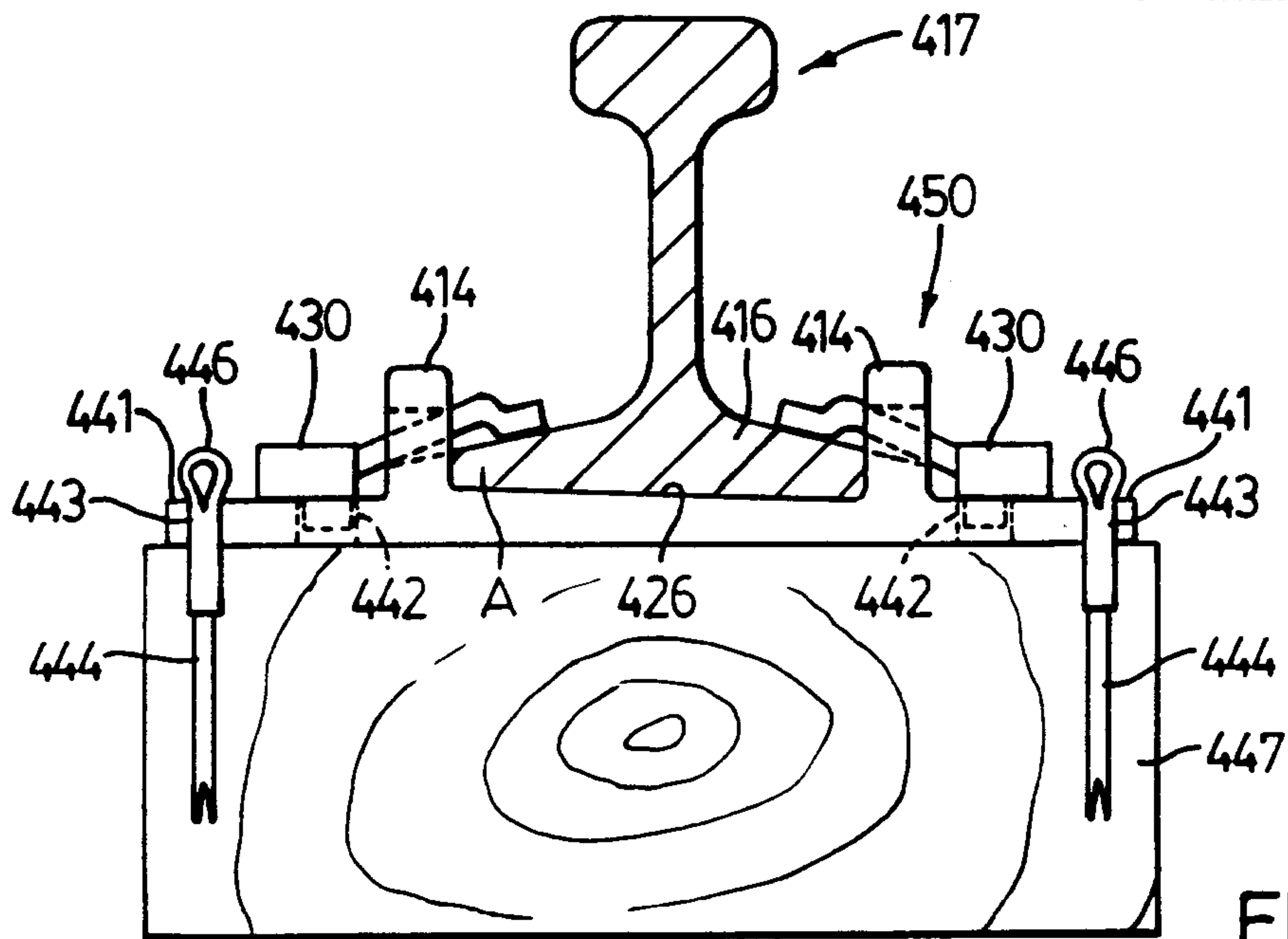
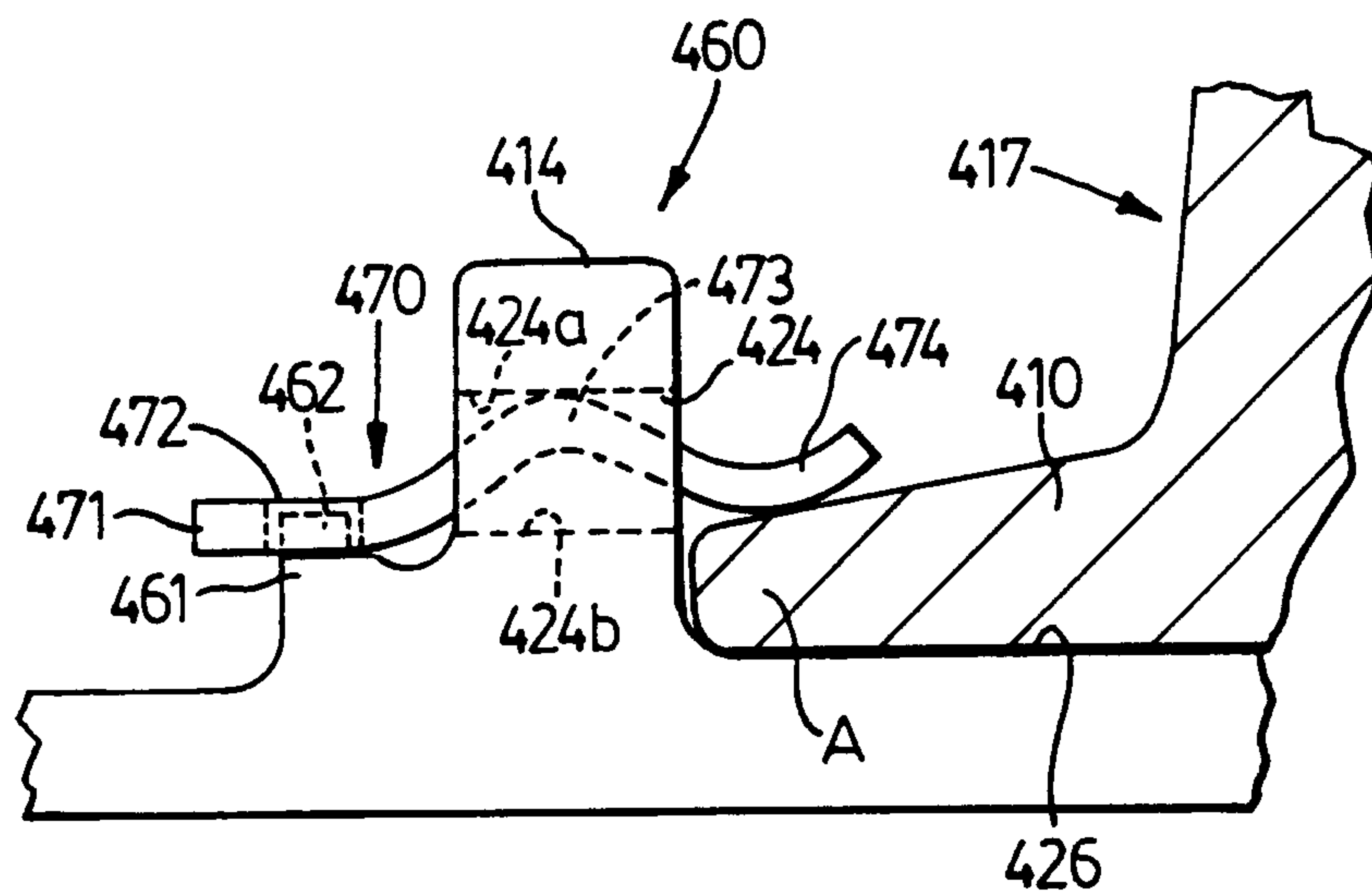
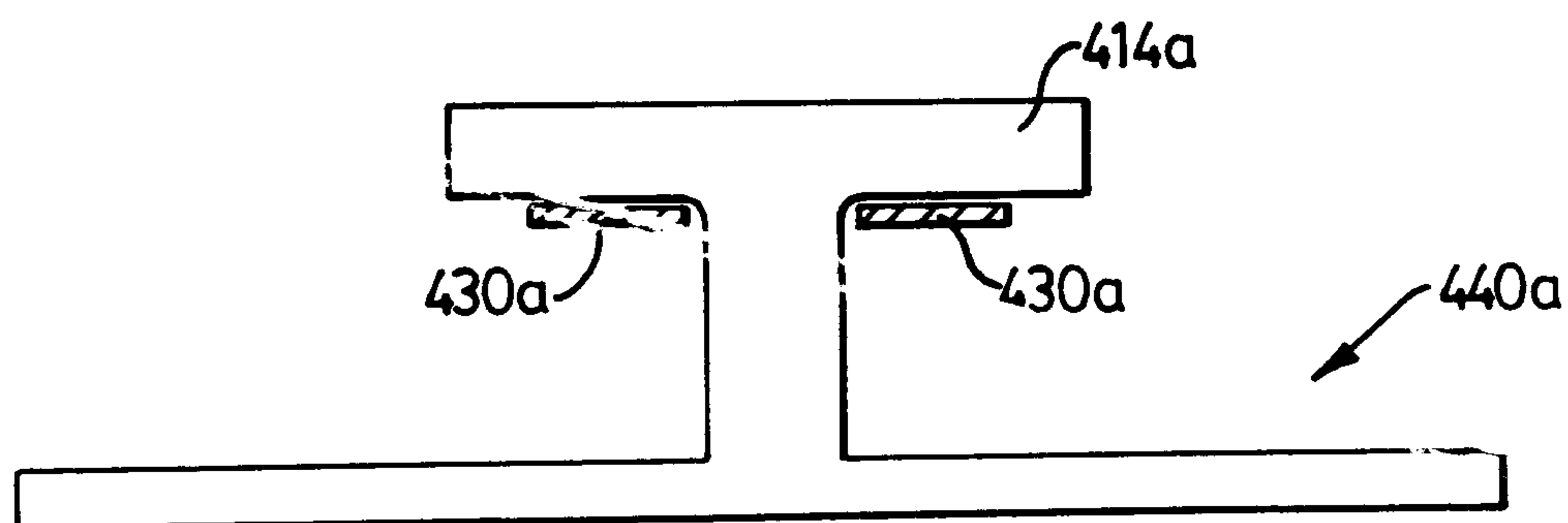
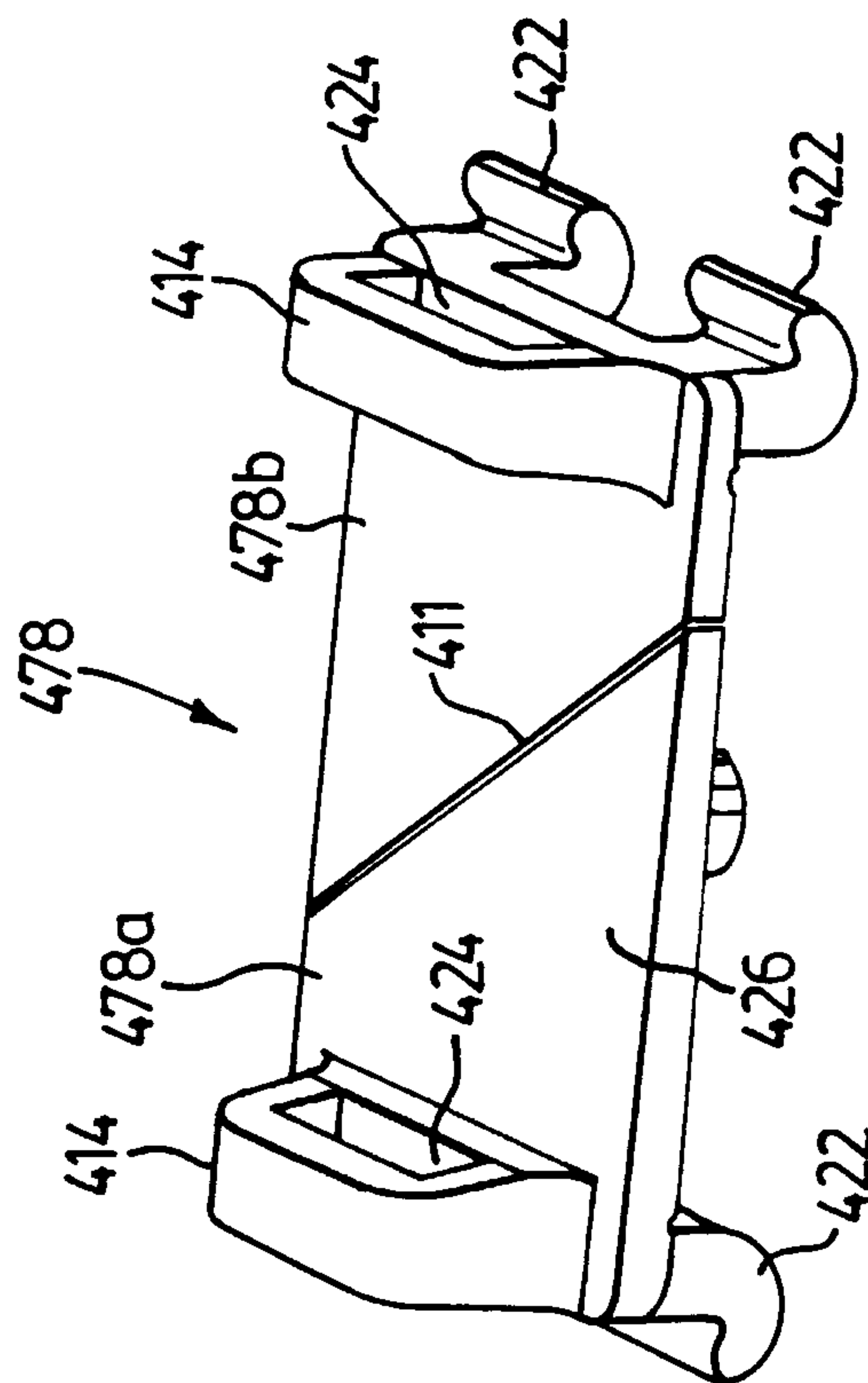
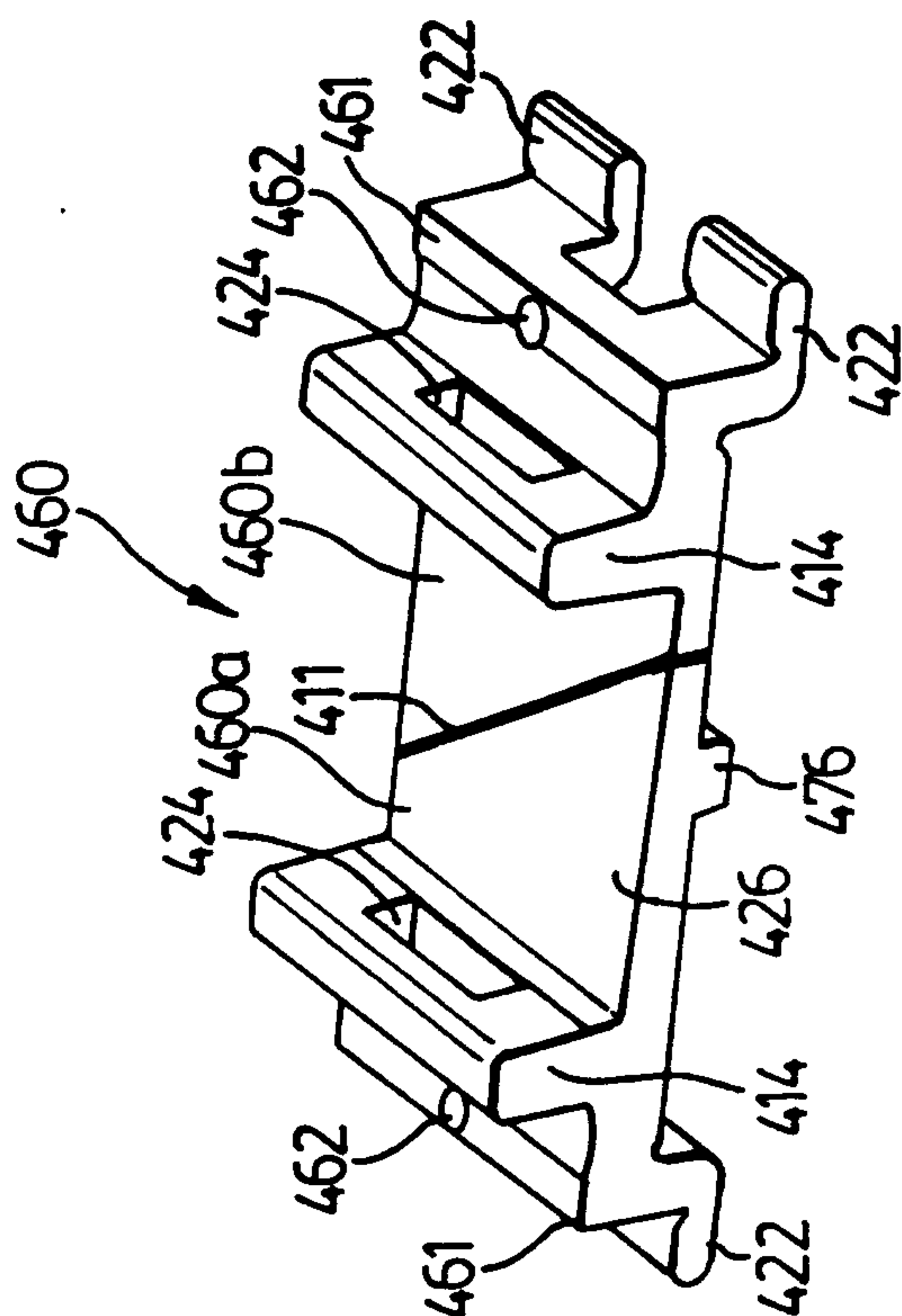


FIG. 23

9/15

FIG. 24FIG. 33**SUBSTITUTE SHEET**

10/15

FIG. 26FIG. 25**SUBSTITUTE SHEET**

11/15

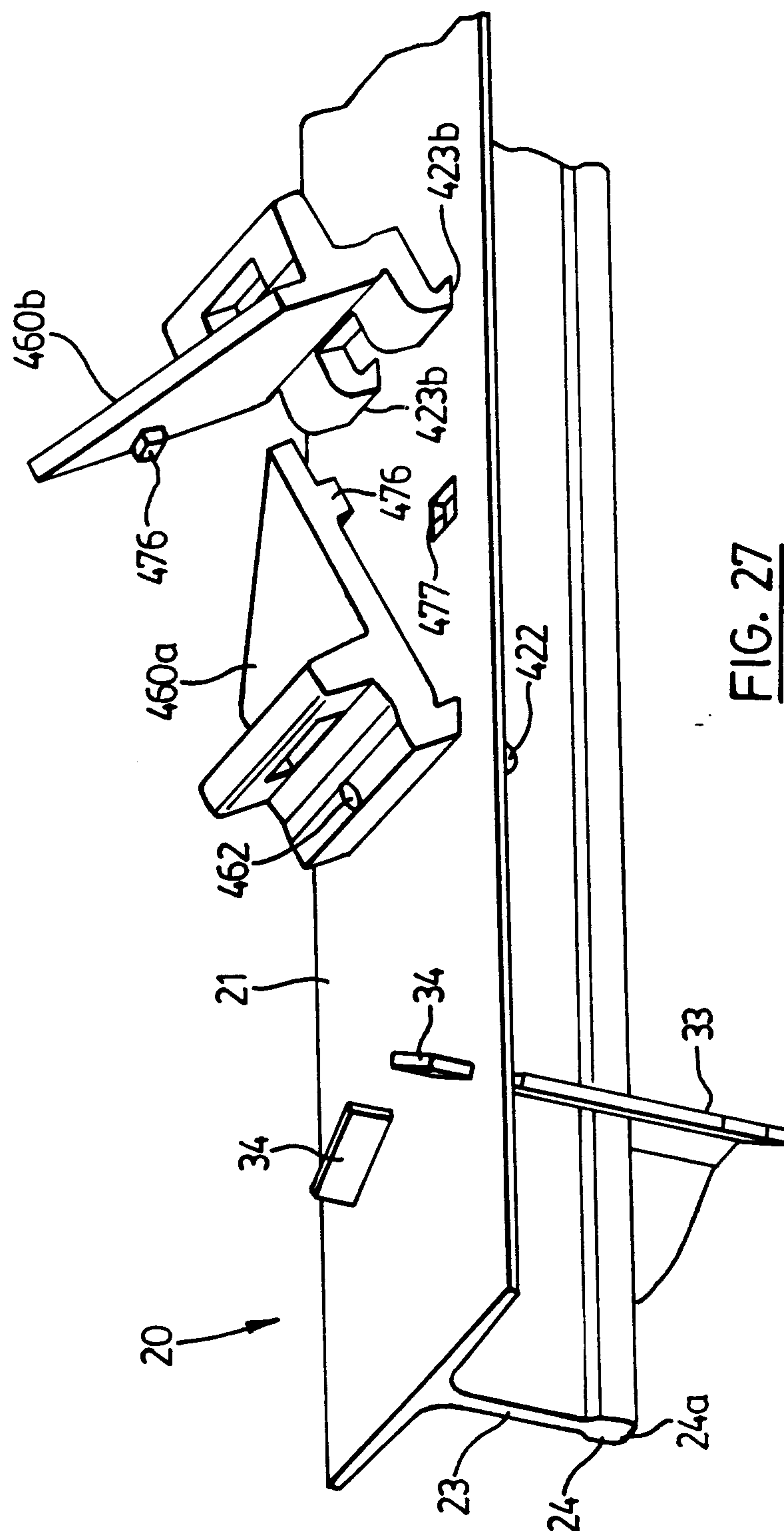


FIG. 27

SUBSTITUTE SHEET

2164115

12/15

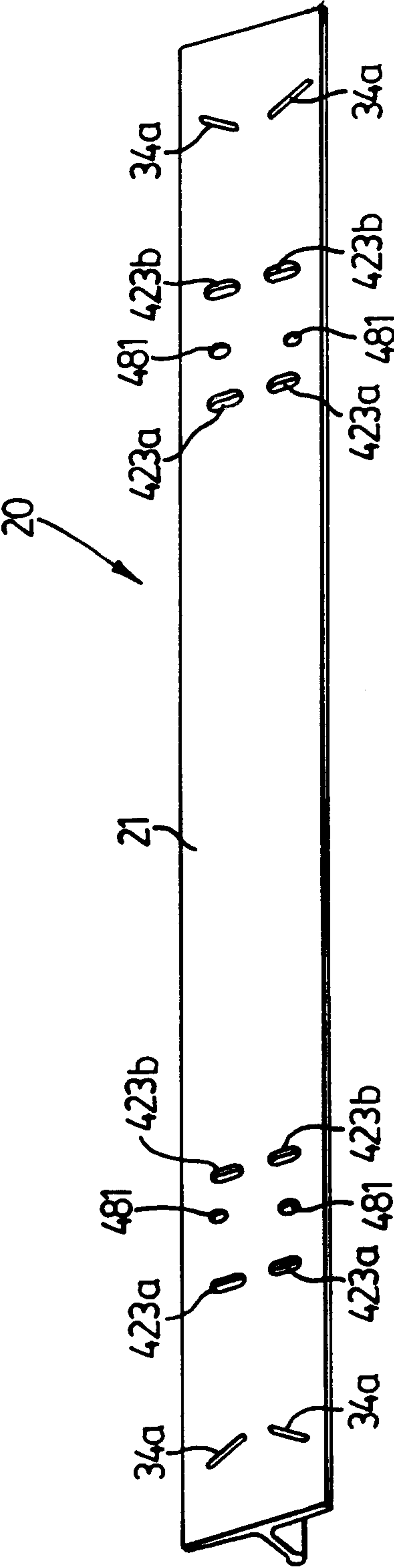


FIG. 28

2164115

14/15

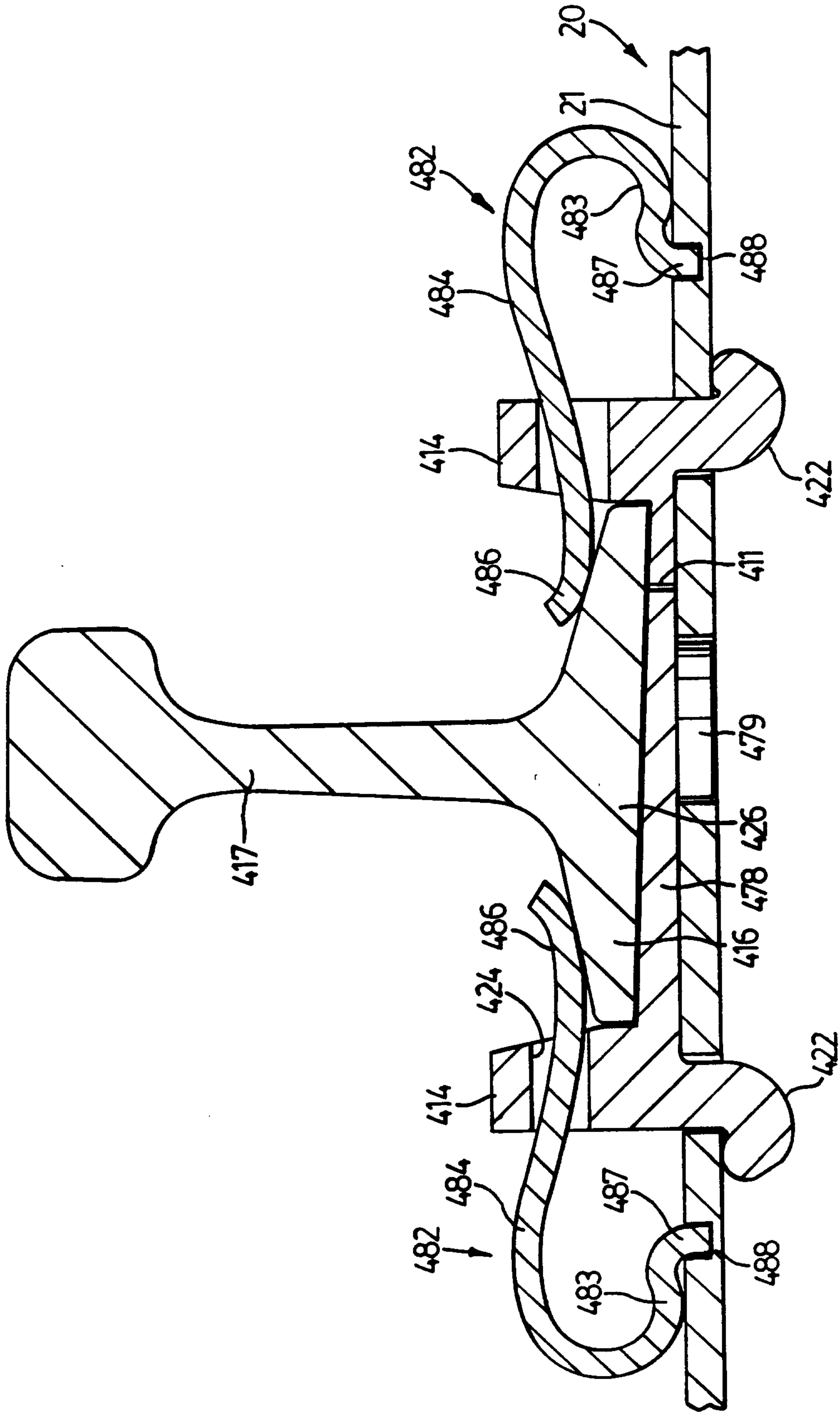


FIG. 30

2164115

15/15

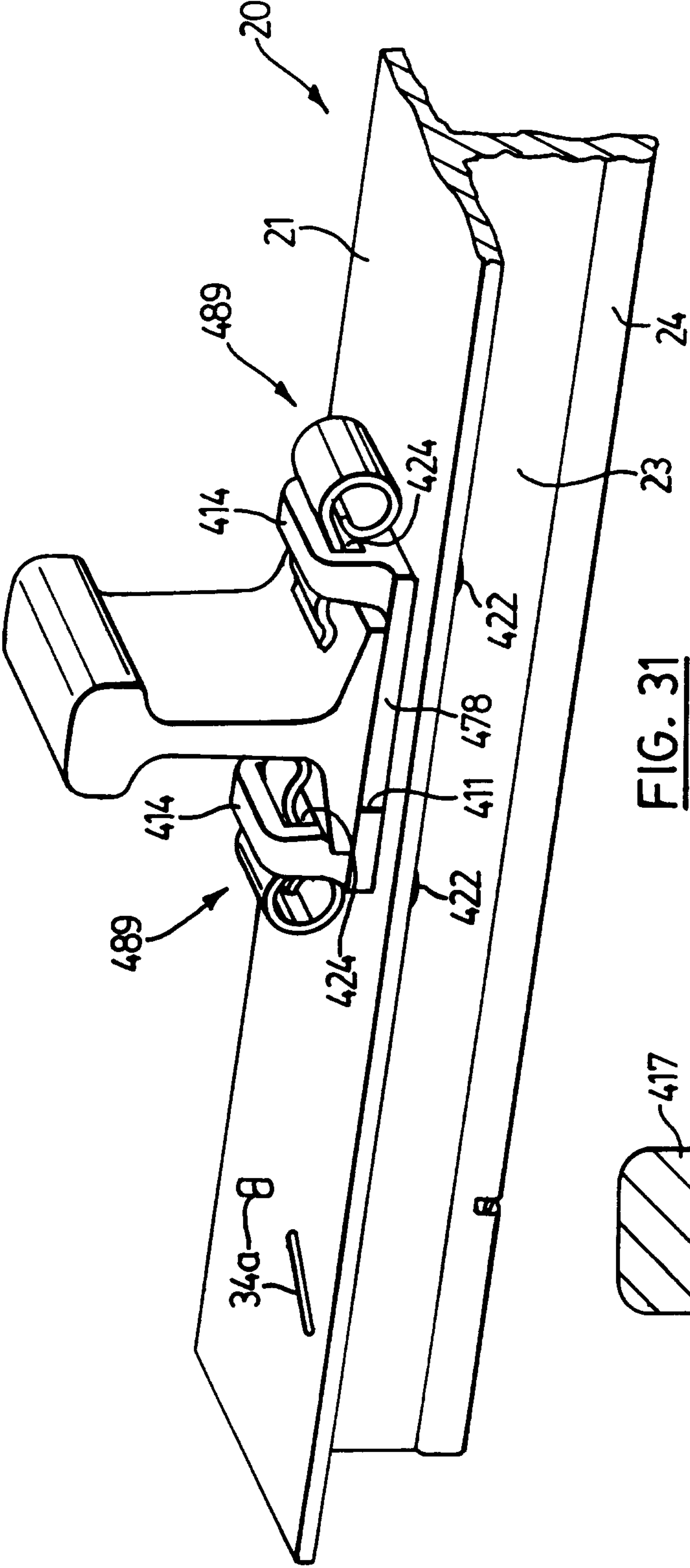


FIG. 31

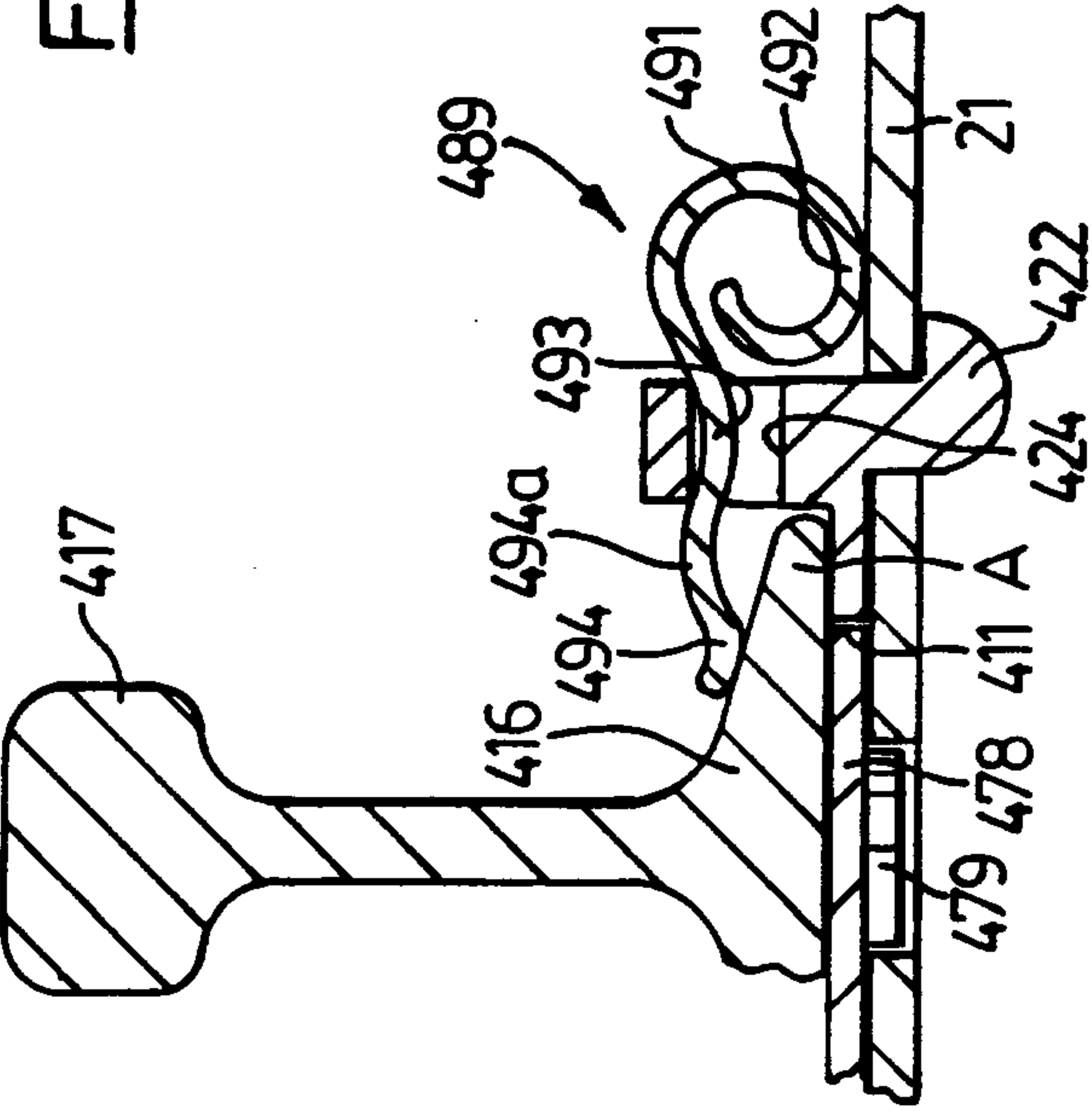


FIG. 32

SUBSTITUTE SHEET