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(54) **SAFETY DEVICE FOR PREVENTING RAIL BUCKLING AND MOVEMENT**

(57) Relating to equipment to prevent the buckling and shifting of rails in which members sandwiching top and bottom faces of a sleeper are tightened by means of fasteners, the direction of tightening force for the sleeper having a trapezoidal cross-section is concentrated along trapezoidal slopes,
and the present invention of safety equipment for preventing the buckling and shifting of the rails comprising a lower fixing member, said lower fixing member 100 including lower joints 110 and 120, an upper fixing member 200 including upper joints 210 and 220, and fasteners tightening the lower and upper joints 110, 120, 210 and 220, and regarding to the fasteners, tightening is done in the longitudinal direction of the fasteners and in parallel to the trapezoidal slopes of the sleeper.

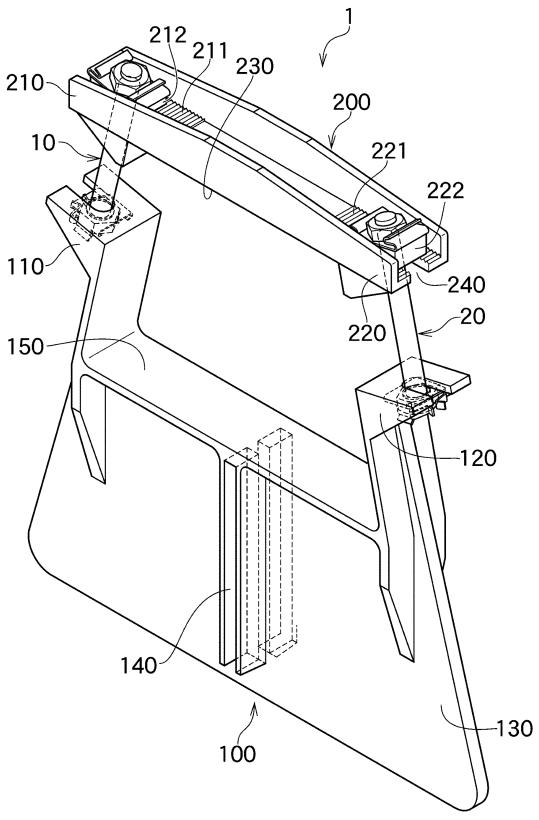

Fig. 1

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Description

[Technical Field]

[0001] The present invention relates to equipment having a structure to tighten members sandwiching top and bottom faces of a sleeper by fasteners for preventing the buckling and shifting of rails.

[Background Art]

[0002] To maintain safe services of railway vehicles running on the rails, it is important to prevent the buckling and shifting of the rails. As an example, there are some equipment (cf patent document 1) to prevent the buckling of the rails by preventing a position of the rails fixed to the sleeper from being shifted. When mounting such equipment on the sleeper, members sandwiching the top and bottom faces of the sleeper may be tightened vertically by the left and right fasteners; that is, fixing the equipment by so-called vertical tightening is generally done.

[0003] In addition, in the equipment related to the rails, the fasteners are sometimes loosened by the vibration and the shock from the vehicles running on the rails. Now fittings for detent of any nuts have been developed (cf patent document 2).

[Description of the Prior Art]

[Patent Documents]

[0004]

[Patent Document 1]Japanese Unexamined Patent Application Publication No. 2010-229642
[Patent Document 2]Japanese Patent No. 5641511

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0005] Previously, the rectangular parallelepiped wooden sleepers were the mainstream but the sleepers of various materials have recently been used instead of the wooden sleepers, and in many cases, the cross-section of the sleepers of these various materials is a trapezoid. The conventional equipment have a problem that when the sleeper having a trapezoidal slope is tightened by the vertical tightening, the direction in which tightening force is concentrated does not follow the trapezoidal slopes.

[0006] Furthermore, in order to prevent the buckling of the rails, it should be put into consideration that the rails may be shifted in the longitudinal direction not only of the sleeper but also of the tracks. The equipment for preventing the buckling of the rails is required to have a structure for preventing the shifting of the rails fixed to the sleeper by allowing multi-directional resistance to be generated.

[0007] Therefore, relating to equipment to prevent the buckling and shifting of the rails in which the members sandwiching the top and bottom faces of the sleeper are tightened by means of the fasteners, it is an object the present invention to provide equipment in which the direction of tightening force for the sleeper having a trapezoidal cross-section is concentrated along the trapezoidal slopes.

[0008] Another object of the present invention is to provide equipment which can lighten a burden of mounting and maintenance work by use of a rail creep prevention plate and linking devices in combination with the known equipment for preventing the buckling and shifting of the rails fixed to the sleeper to generate the longitudinal directional resistance of the sleeper thereof by providing a buckling prevention plate restricted within the ballasts such that the rails fixed to the sleeper is prevented from buckling and shifting more effectively as a result of allowing the multi-directional resistance of the sleeper to be generated.

[Means for solving the problem]

[0009] In order to achieve the above objective, according to the present invention, the claim 1 is directed to safety equipment for preventing the buckling and shifting of rails, comprising: a lower fixing member having a lower sleeper support supporting a bottom face and lower trapezoidal slopes of a sleeper whose cross-section is a trapezoid exclusive of a square and a rectangle, and a pair of lower joints formed at outer side ends of the lower sleeper support in lateral symmetry; an upper fixing member having an upper sleeper support supporting a top face and upper trapezoidal slopes of the sleeper whose cross-section is the trapezoid exclusive of the square and the rectangle, and a pair of the upper joints formed at outer side ends of the upper sleeper support in lateral symmetry; a left fastener tightening the upper and lower joints provided on the left side; a right fastener tightening the upper and lower joints provided on the right side; and the left and right fasteners tightening up such that longitudinal directions of the left and right fasteners are in parallel to the trapezoidal slopes of the sleeper, respectively.

[0010] The claim 2 is directed to the safety equipment for preventing the buckling and shifting of the rails, wherein the lower fixing member comprises a rail creep prevention plate insertion space.

[0011] The claim 3 is directed to the safety equipment for preventing the buckling and shifting of the rails, further comprising a linking device to connect the safety equipment for preventing the buckling and shifting of the rails.

[0012] The claim 4 is directed to the safety equipment for preventing the buckling and shifting of the rails, in which the upper joint, comprising: a joint piece holder; a removable joint piece; and said joint piece holder and

said joint piece including a linking device holder which has a serrated portion; said linking device including a joint bar which has serrated portions on both faces of the linking device; and said linking device being sandwiched by the joint piece holder and the joint piece; and said linking device being tightened by the left and right fasteners.

[0013] The claim 5 is directed to the safety equipment for preventing the buckling and shifting of the rails, wherein at least one set of the upper and lower joints provided on the left side and the upper and lower joints provided on the right side has the removable joint piece.

[0014] The claim 6 is directed to the safety equipment for preventing the buckling and shifting of the rails, in which said lower joint including a structure to prevent the left and right fasteners from falling off and loosening in which a fastener fall-off and looseness prevention fitting is used; and said upper joint including a structure to prevent the left and right fasteners from loosening in which a fastener looseness prevention fitting is used.

[Effects of the Invention]

[0015] As present invention of the safety equipment for preventing the buckling and shifting of the rails, by the fasteners tightening up such that a longitudinal direction of the fasteners are in parallel to the trapezoidal slopes of the sleeper, so-called slant tightening, has an effect on a tightening force concentrating along the trapezoidal slopes of the sleeper. In this invention, the slant tightening becomes possible that the fastener contact face i.e. the face which contacts a bolt head or a nut is vertical in relation to the trapezoidal slope of the sleeper. The slant tightening strengthens the tightening force, and is useful for the site of much vibration and shock where the strong tightening force is required. The strong tightening force increases the durability of the safety equipment for preventing the buckling and shifting of the rails of the present invention, and to increase the durability improves the safe services of the railways.

[0016] In addition, the present invention of the safety equipment for preventing the buckling and shifting of the rails prevents more effectively the buckling and shifting of the rails by generating a multi-directional resistance including longitudinal and lateral directional resistance exerted by a buckling prevention plate used in combination with the rail creep prevention plate restricted within the ballasts. In addition, the safety equipment for preventing the buckling and shifting of the rails used in combination with or connected to the linking device absorbs the vibration and the shock from the vehicles running on the rails and generates not only the longitudinal directional resistance of the sleepers but also the multi-directional resistance thereof. By generating the multi-directional resistance, the safety equipment for preventing the buckling and shifting of the rails maintains a distance between the adjourning sleepers and to prevent the buckling and shifting of the rails.

[0017] In addition, the present invention of the safety equipment for preventing the buckling and shifting of the rails prevents the shifting into the railroad direction by bringing the serrated portion of the joint bar of the linking device and that of the linking device holder of the upper fixing member into mesh with each other when the serrated portions are tightened by the fasteners.

[0018] In addition, the present invention of the safety equipment for preventing the buckling and shifting of the rails makes it possible to do slant tightening by mounting removable joint pieces onto the conventional equipment. The fastener contact face of each removable joint piece makes it possible to do slant tightening by being vertical in relation to the trapezoidal slopes of the sleeper.

[0019] In addition, the present invention of the safety equipment for preventing the buckling and shifting of the rails used in combination with the fastener fall-off and looseness prevention fitting at each lower joint has an effect to prevent the tightening force of each fastener from declining as a result of its looseness and falling off, and to maintain the durability of the safety equipment against the vibration and the shock from the vehicles running on the rails. Furthermore, the present invention of the safety equipment for preventing the buckling and shifting of the rails has an effect to lighten the burden of mounting it and its maintenance work by track maintenance workers.

[Brief Description of Drawings]

[0020]

FIG. 1 is a perspective view of safety equipment for preventing the buckling and shifting of the rails as embodiment 1:

FIG. 2 is a comparison between vertical tightening and slant tightening:

FIG. 3 are views of the way a rail creep prevention plate is attached as embodiment 1; (a) is a front view of the safety equipment for preventing the buckling and shifting of the rails used in combination with the twin rail creep prevention plate extending on both sides of a buckling prevention plate, (b) is a front view of the twin rail creep prevention plate, (c) is a bottom view of the twin rail creep prevention plate, (d) is a front view of the single rail creep prevention plate extending on only one side of the buckling prevention plate, (e) is a bottom view of the single rail creep prevention plate, (f) is a back view of the single rail creep prevention plate, (g) is a bottom view seen from back side of the single rail creep prevention plate, and (h) is a right side view of the safety equipment for preventing the buckling and shifting of the rails used in combination with the twin rail creep prevention plate:

FIG. 4 are views of a linking device installed to an upper fixing member as embodiment 1; (a) is a top view, (b) is a front view with local section of right-

upper joint, and (c) is a right side view:

FIG. 5 are views of a fastener fall-off and looseness prevention fitting as embodiment 1; (a) is a top view, (b) is a front view, and (c) is a right side view:

FIG. 6 are views of inserting a bolt for right side with a fastener fall-off and looseness prevention fitting into a fastener insertion space at a right-lower joint as embodiment 1; (a) is a front view with local section of the right-lower joint, (b) is a bottom view with local section of a lower sleeper support, and (c) is a right side view:

FIG. 7 is a description diagram of mounting process of the safety equipment for preventing the buckling and shifting of the rails as embodiment 1:

FIG. 8 is a bird's eye view of mounting the safety equipment for preventing the buckling and shifting of the rails as embodiment 1: and

FIG. 9 is a description diagram of mounting process of the safety equipment for preventing the buckling and shifting of the rails as embodiment 2.

[Description of Embodiments]

[0021] The following embodiments will now be described with reference to the accompanying drawings.

[0022] In this invention, a fastener can mean not only a pair of bolt and nut, but also one of the bolt or nut. And a longitudinal direction can mean a railroad direction, and a lateral direction can mean a longitudinal direction of a sleeper. And a creep can mean rails with the sleepers shifting in the railroad direction. And a trapezoid means a flat shape with four straight sides, one pair of opposite sides being parallel while the other pair not being parallel and said trapezoid does not include a square and a rectangle.

[Embodiment 1]

[0023] FIG.1 is a perspective view showing an external appearance of safety equipment 1 for preventing the buckling and shifting of rails.

[0024] First, the structure of each part of the safety equipment 1 will be described as follows. Reference numerals 100 is a lower fixing member. The lower fixing member 100 includes a lower joint 110 on the left side, a lower joint 120 on the right side, a buckling prevention plate 130, a rail creep prevention plate insertion space 140, and a lower sleeper support 150. The lower sleeper support 150 supports a bottom face and lower trapezoidal slopes of a sleeper whose cross-section is a trapezoid. The pair of the lower joints of the lower fixing member 100 are formed at the outer side ends of the lower sleeper support 150 in lateral symmetry. Hereinafter, a left-lower joint 110 means the lower joint 110 provided on the left side and a right-lower joint 120 means the lower joint 120 provided on the right side.

[0025] Reference numerals 200 is an upper fixing member. The upper fixing member 200 includes an upper joint 210 on the left side, an upper joint 220 on the right side, and an upper sleeper support 230. The upper sleeper support 230 supports a top face and upper trapezoidal slopes of the sleeper whose cross-section is the trapezoid. The pair of the upper joints of the upper fixing member 200 are formed at the outer side ends of the upper sleeper support 230 in lateral symmetry. Hereinafter, a left-upper joint 210 means the upper joint 210 provided on the left side and a right-upper joint 220 means the upper joint 220 provided on the right side.

[0026] In this embodiment, the left-upper joint 210 includes a left-upper joint piece holder 211 and a removable left-upper joint piece 212, and the right-upper joint 220 includes a right-upper joint piece holder 221 and a removable right-upper joint piece 222. The upper joint piece holder, i.e. each of the left-upper joint piece holder 211 and the right-upper joint piece holder 221 has a serrated portion, and the bottom face of the upper joint piece, i.e. each of the left-upper joint piece 212 and the right-upper joint piece 222 has a serrated portion, too. The bottom face of the left-upper joint piece 212 and the left-upper joint piece holder 211 mesh with each other, and the bottom face of the right-upper joint piece 222 and the right-upper joint piece holder 221 mesh with each other, too.

[0027] The lower joint, i.e. each of the left-lower joint 110 and the right-lower joint 120 includes a fastener contact face which is vertical in relation to the trapezoidal slope of the sleeper. Referring to the fastener contact face, it may be attached to a fitting, which will be described later as a fastener fall-off and looseness prevention fitting 500 and a fastener looseness prevention fitting 600 provided between the fastener contact face and the fastener. The upper joint piece of each upper joint, i.e. each of the left-upper joint 210 and the right-upper joint 220 includes the fastener contact face which is vertical in relation to the trapezoidal slope of the sleeper. The left joint, i.e. each of the left-lower joint 110 and the left-upper joint 210 is tightened by a left fastener 10. Similarly, the right joint, i.e. each of the right-lower joint 120 and the right-upper joint 220 is tightened by a right fastener 20.

[0028] Because the joint, i.e. each of the left-lower joint 110, the right-lower joint 120, the left-upper joint 210, and the right-upper joint 220 has a structure including the fastener contact face which is vertical in relation to the trapezoidal slope of the sleeper, the fastener, i.e. each of the left fastener 10 and the right fastener 20 tightens up such that the longitudinal direction of each of the fasteners is in parallel to the trapezoidal slope of the sleeper, respectively.

[0029] That is, the safety equipment 1 has an effect on a tightening force concentrating along the trapezoidal slopes of the sleeper as mentioned as slant tightening in FIG. 2.

[0030] The safety equipment 1 prevents the buckling and shifting of the rails fixed the sleepers because the lateral directional resistance is generated by the buckling prevention plate 130 restricted within the ballasts. By us-

ing the means of generating not only the lateral directional resistance but also the multi-directional resistance, preventing the buckling and shifting of the rails may be more effective.

[0031] As one of the means of generating the multi-directional resistance, it is preferable to use a rail creep prevention plate. In this embodiment, use of each the rail creep prevention plate is shown as from FIG. 3(b) to 3(g), i.e. the single rail creep prevention plate 310 and the twin rail creep prevention plate 320. Each rail creep prevention plate is formed with a notch and a hook. In the single rail creep prevention plate 310, the notch 311 is formed at a lower area inwardly but close to the shorter side and the hook 312 is formed at the shorter side near said notch 311. In the twin rail creep prevention plate 320, the notch 321 is formed at a lower center area and the hook 322 is formed at the outer side of the notch 321. FIG. 3(a) and FIG. 3(h) show the twin rail creep prevention plate 320 is attached into the rail creep prevention plate insertion space 140. The twin rail creep prevention plate 320 is fixed by the notch 321 fitted to the rail creep prevention plate insertion space 140. Then, the hook 322 prevents the twin rail creep prevention plate 320 from falling off the rail creep prevention plate insertion space 140. Relating also to the fixing and prevention of falling off, the single rail creep prevention plate 310 is the same as the twin rail creep prevention plate 320. After mounting the safety equipment 1 used in combination with any one of the rail creep prevention plate on the sleeper, most part of the lower fixing member 100 attached with any one of the rail creep prevention plate is within the ballasts.

[0032] That is, the safety equipment 1 used in combination with any one of the rail creep prevention plate prevents more effectively the buckling and shifting of the rails by generating the multi-directional resistance including the longitudinal and lateral directional resistance exerted by the buckling prevention plate 130 used in combination with the rail creep prevention plate restricted within the ballasts.

[0033] As another means for generating the multi-directional resistance, it is preferred to use a linking device. FIG. 4 are views of the linking device 400 installed to the upper fixing member 200 of the safety equipment 1. The relationship between parts of the linking device 400 and the upper fixing member 200 is illustrated by FIG. 4. The linking device 400 includes a bolt insertion space 410 and a joint bar 420 which has serrated portions on both faces thereof. The bolt insertion space 410 is formed at opposite side ends of the linking device 400. And, the bolt insertion space 410 has a slit-like shape. Tops of the upper fixing member 200 and the linking device 400 have substantially open channel shapes, and the inside width of the upper bottom face of the upper fixing member 200 is larger than the outside width of the bottom face of the linking device 400. The upper fixing member 200 is formed with bolt insertion spaces 240 and linking device holders 250 which have serrated portions. The bolt insertion spaces 240 are formed at opposite side ends of the upper fixing member 200. And, each of the bolt insertion spaces 240 has a slit-like shape. In this case, each of the linking device holders 250 cooperates with the bottom face of each upper joint piece and each upper joint piece holder. Regarding the position of each bolt insertion space 240 and each upper joint piece and each upper joint piece holder, refer to FIG. 1. The linking device 400 is sandwiched by each upper joint piece holder and each upper joint piece and tightened by each fastener.

[0034] That is, the safety equipment 1 used in combination with or connected to the linking device 400 has an effect to prevent the shifting into the railroad direction by bringing the serrated portions of the joint bar 420 of the linking device 400 and that of the linking device holders 250 of the upper fixing member 200 into mesh with each other when the serrated portions are tightened by each fastener. In addition, the safety equipment 1 used in combination with or connected to the linking device 400 absorbs the vibration and the shock from the vehicles running on the rails and generates not only the lateral directional resistance but also the multi-directional resistance. By generating the multi-directional resistance, the safety equipment 1 has an effect to maintain the distance between the adjourning sleepers and to prevent the buckling and shifting of the rails.

[0035] Not only the tightening force concentrates along the trapezoidal slopes of the sleeper but also the strength of the safety equipment 1 itself is one of the most important features to affect its durability against the vibration and the shock from the vehicles running on the rails.

[0036] As one of means to enhance the strength of the safety equipment 1 itself, it is preferable to use a tough spheroidal graphite cast iron for the material of the lower fixing member 100, the upper fixing member 200, each rail creep prevention plate and the linking device 400, and it is more preferable to use a material having a characteristic equal to or more superior than that of the spheroidal graphite cast iron.

[0037] That is, the safety equipment 1 whose material is tough spheroidal graphite cast iron may reduce the risk of the fracture of all parts.

[0038] Referring to the work of mounting a plurality of the safety equipment 1, it is required to lighten a burden of mounting it and its maintenance work.

[0039] As one of means to lighten the burden of mounting the safety equipment 1 and its maintenance work, it is preferable to make a structure to prevent the fastener on each lower joint from falling off and loosening. In this embodiment, the fastener fall-off and looseness prevention fitting 500 is used. A shape of the fastener fall-off and looseness prevention fitting 500 is illustrated by FIG. 5. The fastener fall-off and looseness prevention fitting 500 is a generally metal thin plate, and includes a top 510 which is flat-shaped, first roundabouts 530 which are substantially C-shaped extending from boundaries 520 at both end portions of the top 510, fastener holders 540 which extend from the first roundabouts 530 vertically in relation to the top 510, fastener supports 550 which ex-

tend from the fastener holders 540 which are substantially L-shaped, second roundabouts 560 which extend from end portions of the fastener holders 540 via the outer of the boundaries 520 which are curved near the first roundabouts 530, and fastener side stops 570 which extend from the ends of the second roundabouts 560 which are substantially L-shaped to form a bend. In the case of inserting the bolt to the fastener fall-off and looseness prevention fitting 500, the width between each fastener holder 540 has a size to allow the sides of the bolt head to be held resiliently. The fastener support 550 is opened when the bolt head passes the fastener supports 550, and returned to the original shape by the resilience after the bolt head passes. Furthermore, a bolt insertion hole 580 is formed in the top 510. In this case, it is preferable to use a stainless steel sheet having excellent durability and resilience for the fastener fall-off and looseness prevention fitting 500, or it is more preferable to use the material having a characteristic equal to or more superior than that of the stainless steel sheet.

[0040] A structure for inserting the fastener fall-off and looseness prevention fitting 500 is illustrated by FIG. 6. A description of the structure of the left-lower joint 110 is omitted because the structure of the right-lower joint 120 is similar. In the right-lower joint 120, a reinforcement 121 is formed at the side face opposite to the face for supporting the trapezoidal slope of the lower sleeper support 150 and at the side end of the fastener contact face. A fastener insertion space 122 is formed in the space surrounded by the opposite side face for supporting the trapezoidal slope of the lower sleeper support 150, the fastener contact face and the reinforcement 121. The fastener insertion space 122 has a structure to allow the insertion of the fastener fall-off and looseness prevention fitting 500. Specifically, the upside of the fastener insertion space 122 includes a ceiling 123 and a roundabout 124 extending along with a shape of the top 510 and the first roundabout 530 of the fastener fall-off and looseness prevention fitting 500, the downside of the fastener insertion space 122 includes a taper 125 diverging downwardly, and the part of the taper 125 as well as a holder of the second roundabout 560 of the fastener fall-off and looseness prevention fitting 500 includes a notch 126. Furthermore, a bolt insertion 127 is formed in the ceiling 123 of the fastener insertion space 122. The bolt insertion 127 in FIG. 6 has a slit-like shape opening at the side end of the right-lower joint 120, or a long hole as a combination of a rectangle and two semicircles.

[0041] The right fastener 20 i.e. a right bolt 21 or a right nut 22 is inserted in the right-lower joint 120. The right nut 22 will be described later. The fastener fall-off and looseness prevention fitting 500 loaded with the right bolt 21 is inserted into the fastener insertion space 122 of the right-lower joint 120 in FIG. 6. Because the first roundabout 530 of the fastener fall-off and looseness prevention fitting 500 fits in the roundabout 124 of the fastener insertion space 122, the fastener fall-off and looseness prevention fitting 500 prevents looseness and downward fall-off thereof. In other words, because the flat face of the fastener holder 540 holds the side face of the head of the right bolt 21 and the bends of the fastener supports 550 supports the head of the right bolt 21 from below, looseness and fall-off of the right bolt 21 are prevented.

[0042] That is, the safety equipment 1 used in combination with the fastener fall-off and looseness prevention fitting 500 at each lower joint has an effect to prevent the tightening force of each fastener from declining as a result of its looseness and falling off, and to maintain the durability of the safety equipment 1 against the vibration and the shock from the vehicles running on the rails. Furthermore, the safety equipment 1 has an effect to lighten the burden of mounting it and its maintenance work by track maintenance workers.

[0043] As one of means to lighten the burden of mounting the safety equipment 1 and its maintenance work, it is preferable to make a structure to prevent the fastener on each upper joint from loosening. In this embodiment, the fastener looseness prevention fitting 600 is used. A shape of the fastener looseness prevention fitting 600 is illustrated by FIG. 7. The fastener looseness prevention fitting 600 is a generally metal thin plate, and includes a bottom 610 which is flat-shaped, roundabouts 620 which extend roundly from both end portions of the bottom 610 into the direction of the center of the bottom 610, and fastener holders 630 which extend roundly from both end portions of the roundabouts 620 outwardly. In the case of inserting the nut to the fastener looseness prevention fitting 600, the width between the fastener holders 630 has a size to allow the sides of the nut to be held resiliently. Tightening the nut permits the turn by limited friction of the fastener holder 630 shaped roundly, and after the nut tightens, looseness is prevented by the resilience. Furthermore, a bolt insertion hole 640 is formed in the center of the bottom 610. In this case, it is preferable to use the stainless steel sheet having excellent durability and resilience to the fastener looseness prevention fitting 600, or it is more preferable to use the material having the characteristic equal to or more superior than that of the stainless steel sheet.

[0044] The right fastener 20 is inserted in the right-upper joint 220. The right bolt 21 will be described later. The fastener looseness prevention fitting 600 is set on the right-upper joint piece 222 in the right-upper joint 220 and the right nut 22 is inserted from above into said fastener looseness prevention fitting 600 in FIG. 7. A bolt insertion hole 223 is formed in the right-upper joint piece 222. In this case, because the fastener looseness prevention fitting 600 engages an inner wall of the linking device 400 sandwiched by the right-upper joint piece holder 221 and the right-upper joint piece 222, its turn due to looseness is prevented. If the linking device 400 is not used, such turn is prevented because the fastener looseness prevention fitting 600 engages an upper inner wall of the upper fixing member 200. And because the right nut 22 is held by the fastener holder 630 holding the side face of the right nut 22, its looseness is prevented.

[0045] That is, the safety equipment 1 used in combination with the fastener looseness prevention fitting 600 at each upper joint has an effect to prevent the tightening force of each fastener from declining as a result of its looseness and to maintain the durability of the safety equipment 1 against the vibration and the shock from the vehicles running on the rails. Furthermore, the safety equipment 1 has an effect to lighten the burden of mounting it and its maintenance work by track maintenance workers.

[0046] Next, a procedure to mount the safety equipment 1 onto the sleeper S is illustrated by using FIG. 7. Herein, a right portion of the safety equipment 1 will be described. The step regarding the left portion is substantially the same as the right portion.

[0047] In the first step, the lower fixing member 100 is set below the sleeper S.

[0048] In the second step, the fastener fall-off and looseness prevention fitting 500 is inserted into the fastener insertion space 122 of the right-lower joint 120, and subsequently, the right bolt 21 is inserted into the fastener fall-off and looseness prevention fitting 500 from below. If the bolt insertion 127 has the slit-like shape, the fastener fall-off and looseness prevention fitting 500 loaded with the right bolt 21 is inserted in the fastener insertion space 122 of the right-lower joint 120. Then, the right bolt 21 is inserted through the bolt insertion hole 580 in the fastener fall-off and looseness prevention fitting 500 and the bolt insertion space 127 of the right-lower joint 120.

[0049] In the third step, the upper fixing member 200 is set on the sleeper S. Then, the right bolt 21 is inserted through the bolt insertion space 240 at the upper fixing member 200.

[0050] In the fourth step, the linking device 400 is set on the upper fixing member 200. Then, the right bolt 21 is inserted through the bolt insertion space 410 at the linking device 400.

[0051] In the fifth step, the right-upper joint piece 222 is set on the linking device 400. Then, the right bolt 21 is inserted through the bolt insertion hole 223 in the right-upper joint piece 222.

[0052] In the sixth step, the fastener looseness prevention fitting 600 is set on the right-upper joint piece 222. Then, the right bolt 21 is inserted through the bolt insertion hole 640 in the fastener looseness prevention fitting 600.

[0053] In the seventh step, the right nut 22 is attached onto the fastener looseness prevention fitting 600 while turning and tightening is done.

[0054] In this case, because each fastener tightens up such that the longitudinal direction of each fastener is in parallel to the trapezoidal slope of the sleeper S, the tightening force concentrates along the trapezoidal slopes. Thus, this embodiment solves the problem.

[0055] In this embodiment, the right bolt 21 is interchangeable with the right nut 22. In this case, the right nut 22 can be inserted into the fastener fall-off and looseness prevention fitting 500 levelly in relation to the top 510. Then, because the fastener side stop 570 is opened when the nut passes the fastener side stop 570, and returned to the original shape by the resilience after the nut passes, fall-off of the right nut 22 horizontally in relation to the top 510 is prevented. In the case, the width between the fastener holders 540 has a size to allow the sides of the right nut 22 to be held. Then, because the flat face of the fastener holder 540 holds the side face of the right nut 22 and the bends of the fastener supports 550 supports the right nut 22 from below, looseness and downward fall-off of the right nut 22 are prevented. In the case of inserting the right bolt 21 into the fastener looseness prevention fitting 600, the width between the fastener holders 630 has a size to allow the sides of the head of the right bolt 21 to be held resiliently. Regarding the mounting work of the safety equipment 1 to the sleeper S, it is possible to adopt the steps as follows; in the second step, the fastener fall-off and looseness prevention fitting 500 loaded with the right nut 22 being inserted into the fastener insertion space 122 at the right-lower joint 120, and in the seventh step, the right bolt 21 being inserted into the right nut 22 from above before tightening is done.

[0056] FIG. 8 shows an example of mounting the safety equipment 1 as embodiment 1. The safety equipment 1 used in combination with the single rail creep prevention plate 310 attached to the inside of the railway in advance is mounted to a little inner side from ends of the sleeper S in FIG. 8. The safety equipment 1 used in combination with the twin rail creep prevention plate 320 attached in advance is mounted to the center of the sleeper S. Furthermore, each the safety equipment 1 used in combination with the single rail creep prevention plate 310 attached to the inside of the sleeper S in advance is connected to the linking device 400 to forward and rearward counterparts one another.

[0057] Which type of rail creep prevention plate is to be used to each safety equipment 1, is considered depending upon the situation of the tracks i.e. the magnitude of vibration and shock from the vehicles running on the rails and the frequency of earthquakes. Depending upon some situation of the tracks, the rail creep prevention plate may be not used.

[0058] In this case, the multi-directional resistance is generated by use of the safety equipment 1 used in combination with or connected to the linking device 400. The buckling and shifting of the rails fixed the sleeper is more effectively prevented by the multi-directional resistance to be generated. Thus, this embodiment solves the problem.

[Embodiment 2]

[0059] As embodiment 2, FIG. 9 shows an example of a conventional driving type of equipment for preventing the buckling in which the present invention is applied.

[0060] Safety equipment 2 for preventing the buckling and shifting of rails, which is showed as FIG. 9, sandwiches top and bottom faces of a sleeper S whose cross-

section is a trapezoid by means of a lower sleeper support of a lower fixing member 700 and an upper sleeper support of an upper fixing member 800. The lower fixing member 700 includes a left-lower joint 710 and a right-lower joint 720 at outer side ends of the lower sleeper support in lateral symmetry, and the upper fixing member 800 includes a left-upper joint 810 and a right-upper joint 820 at outer side ends of the upper sleeper support in lateral symmetry. The lower sleeper support supports the bottom face and the lower trapezoidal slopes of the sleeper S, and the upper sleeper support supports the top face and the upper trapezoidal slopes of the sleeper S. In this embodiment, the safety equipment 2 has a structure similar to the safety equipment 1 in the way that each fastener does tightening at the joint i.e. at the left-lower joint 710, and the right-lower joint 720 while the tightening is done at the left-upper joint 810 and the right-upper joint 820.

[0061] The conventional driving type of equipment for preventing the buckling features the vertical tightening. In this embodiment, each joint includes a removable joint piece. A fastener contact face of each joint piece is vertical in relation to the trapezoidal slopes of the sleeper S.

[0062] That is, the safety equipment 2 makes it possible to do slant tightening by mounting removable joint pieces onto the conventional equipment.

[0063] A buckling prevention pile plate 900 is driven into the ballasts through the lower fixing member 700 and the upper fixing member 800.

[0064] That is, the safety equipment 2 prevents the buckling and shifting of the rails because the lateral directional resistance is generated by the buckling prevention pile plate 900 restricted within the ballasts.

[0065] A structure of the right-lower joint 720 and the right-upper joint 820 is illustrated by FIG. 9. A description of a structure of the left-lower joint 710 and the left-upper joint 810 is omitted because of the similar structures of the right-lower joint 720 and the right-upper joint 820.

[0066] The right-lower joint 720 includes a removable right-lower joint piece 721. Furthermore, a fastener insertion space 722 is formed in the right-lower joint 720. A part of the side end face of the right-lower joint 720 and a part of the bottom face are formed open. A structure of the fastener insertion space 722 is formed such that it is possible to insert a fastener fall-off and looseness prevention fitting 500 and the right-lower joint piece 721 put together. Specifically, an upper portion of the fastener insertion space 722 includes a ceiling 723 which matches the shape of a top face on the right-lower joint piece 721 and side walls 724 which supports the fastener fall-off and looseness prevention fitting 500, a lower portion of the fastener insertion space 722 includes supports 725. The inside width between the side walls 724 has a size to allow the fastener fall-off and looseness prevention fitting 500 to be held resiliently thereof. The inside width between the supports 725 is less than the outer widths of a first roundabout 530 and a second roundabout 560 of the fastener fall-off and looseness prevention fitting 500. And a bolt insertion hole 726 is formed in the ceiling 723 of the fastener insertion space 722. Said bolt insertion hole 726 is a long hole. In this case, a fastener contact face of the right-lower joint piece 721 is vertical in relation to the trapezoidal slope of the sleeper S. And, a bolt insertion hole 727 is formed in the right-lower joint piece 721.

[0067] The right-upper joint 820 includes a removable right-upper joint piece 821. And, a bolt insertion hole 822 is formed in the right-upper joint 820. Said bolt insertion hole 822 is a long hole. In this case, a fastener contact face of the right-upper joint piece 821 is vertical in relation to the trapezoidal slope of the sleeper S. And, a bolt insertion hole 823 is formed in the right-upper joint piece 821. And, side walls 824 are formed at both side ends of the right-upper joint piece 821. Because the first roundabout 530 engages the side walls 724, the fastener fall-off and looseness prevention fitting 500 is prevented from loosening, and because the first roundabout 530 or the second roundabout 560 is supported by the support 725, the fastener fall-off and looseness prevention fitting 500 is prevented from falling off downwardly. A fastener looseness prevention fitting 600 is prevented from turning because it engages the inner face of the side walls 824. Referring to the mounting work of a right bolt 21 and a right nut 22 and the prevention of looseness and fall-off of the fastener fall-off and looseness prevention fitting 500 and the looseness of the fastener looseness prevention fitting 600, the description is omitted because it is substantially the same as embodiment 1.

[0068] Next, a procedure to mount the safety equipment 2 onto the sleeper S is illustrated by FIG. 9. Herein, the right portion of the safety equipment 2 will be described. The step regarding the left portion is substantially the same as the right portion.

[0069] In the first step, the lower fixing member 700 is set below the sleeper S.

[0070] In the second step, the fastener fall-off and looseness prevention fitting 500 and right-lower joint piece 721 are inserted into the fastener insertion space 722 of the right-lower joint 720, and subsequently, the right bolt 21 is inserted into the fastener fall-off and looseness prevention fitting 500 from below. Then, the right bolt 21 is inserted through the bolt insertion hole 580 in the fastener fall-off and looseness prevention fitting 500, the bolt insertion hole 727 in the right-lower joint piece 721 and the bolt insertion hole 726 in the right-lower joint 720.

[0071] In the third step, the upper fixing member 800 is set on the sleeper S. Then, the right bolt 21 is inserted through the bolt insertion hole 822 in the right-upper joint 820.

[0072] In the fourth step, the right-upper joint piece 821 is set on the right-upper joint 820. Then, the right bolt 21 is inserted through the bolt insertion hole 823 in the right-upper joint piece 821.

[0073] In the fifth step, the fastener looseness prevention fitting 600 is set on the right-upper joint piece 821. Then, the right bolt 21 is inserted through the bolt inser-

tion hole 640 in the fastener looseness prevention fitting 600.

[0074] In the sixth step, the right nut 22 is inserted into the fastener looseness prevention fitting 600 while turning and tightening is done.

[0075] In this case, because each fastener tightens up such that the longitudinal direction of each fastener is in parallel to the trapezoidal slope of the sleeper S, the tightening force concentrates along the trapezoidal slopes. Thus, this embodiment solves the problem.

[0076] In this embodiment, the right bolt 21 is interchangeable with the right nut 22, too. In this case, reference to the installing the right bolt 21 and right nut 22 and the prevention of looseness and fall-off of the looseness of the fastener fall-off and looseness prevention fitting 500 and the looseness of the fastener looseness prevention fitting 600, will be omitted because it is substantially the same as embodiment 1. Regarding the mounting work of the safety equipment 2 to the sleeper S, it is possible to adopt the steps as follows; in the second step, the fastener fall-off and looseness prevention fitting 500 loaded with the right nut 22 being inserted into the fastener insertion space 722 at the right-lower joint 720, and in the sixth step, the right bolt 21 being inserted into the right nut 22 from above before tightening is done.

[0077] It is one of features in this embodiment that the vertical tightening is possible without the use of any joint pieces. While mounting the safety equipment 2 to the sleeper S, it is possible to adopt the means without the use of any joint pieces in the second and fourth steps.

[0078] That is, the safety equipment 2 is open to the option to adopt either vertical tightening or slant tightening. Referring to judgment whether to adopt either vertical tightening or slant tightening, it depends upon the situation of mounting site.

[0079] Thus, this invention is described referring to the embodiments, but technical scope of this invention is not limited by the following as the description of the embodiments. For example, regarding to the structure to prevent looseness and fall-off of the fasteners, there are plenty of alternative such as the fastener itself having the structure to be provided with such means. The means are not limited to the use of the fastener fall-off and looseness prevention fitting 500 and the fastener looseness prevention fitting 600. If there are not necessary to use the fastener fall-off and looseness prevention fitting 500, the structure of each fastener insertion space might as well be simplified. Referring to installing and mounting work, if there are not necessary to link the safety equipment 1, the structure of the upper fixing member 200 might as well be simplified. And, the above-mentioned procedure to mount the safety equipment 1 to the sleepers are merely examples, the number of the safety equipment 1 for the sleepers is optional, and whether to use the rail creep prevention plate to the safety equipment 1 or not is optional, too. These arrangements are within technical scope of this invention.

[Description of the reference numerals]

[0080] 1 and 2 ... safety equipment for preventing the buckling and shifting of rails.

10 ... a left fastener, 20 ... a right fastener, 21 ... a right bolt, and 22 ... a right nut. 100 ... a lower fixing member, 110 ... a left-lower joint, 120 ... a right-lower joint, 121 ... a reinforcement, 122 ... a fastener insertion space, 123 ... a ceiling, 124 ... a roundabout, 125 ... a taper, 126 ... a notch, 127 ... a bolt insertion space, 130 ... a buckling prevention plate, 140 ... a rail creep prevention plate insertion space, and 150 ... a lower sleeper support.

200 ... an upper fixing member, 210 ... a left-upper joint, 211 ... a left-upper joint piece holder, 212 ... a left-upper joint piece, 220 ... a right-upper joint, 221 ... a right-upper joint piece holder, 222 ... a right-upper joint piece, 223 ... a bolt insertion hole, 230 ... an upper sleeper support, 240 ... a bolt insertion space, and 250 ... a linking device holder.

310 ... a single rail creep prevention plate, 311 ... a notch, 312 ... a hook, 320 ... a twin rail creep prevention plate, 321 ... a notch, and 322 ... a hook.

400 ... a linking device, 410 ... a bolt insertion space, and 420 ... a joint bar.

500 ... a fastener fall-off and looseness prevention fitting, 510 ... a top, 520 ... a boundary, 530 ... a first roundabout, 540 ... a fastener holder, 550 ... a fastener support, 560 ... a second roundabout, 570 ... a fastener side stop, and 580 ... a bolt insertion hole.

600 ... a fastener looseness prevention fitting, 610 ... a bottom, 620 ... a roundabout, 630 ... a fastener holder, and 640 ... a bolt insertion hole.

700 ... a lower fixing member, 710 ... a left-lower joint, 720 ... a right-lower joint, 721 ... a right-lower joint piece, 722 ... a fastener insertion space, 723 ... a ceiling, 724 ... a side wall, 725 ... a support, 726 and 727 ... a bolt insertion hole. 800 ... an upper fixing member, 810 ... a left-upper joint, 820 ... a right-upper joint, 821 ... a right-upper joint piece, 822 and 823 ... a bolt insertion hole, 824 ... a side wall.

900 ... a buckling prevention pile plate.

S ... a sleeper.

Claims

1. Safety equipment for preventing the buckling and shifting of rails, comprising:

   a lower fixing member having a lower sleeper support supporting a bottom face and lower trapezoidal slopes of a sleeper whose cross-section is a trapezoid exclusive of a square and a rectangle, and a pair of lower joints formed at outer side ends of the lower sleeper support in lateral symmetry;

   an upper fixing member having an upper sleeper support supporting a top face and upper trape-

zoidal slopes of the sleeper whose cross-section is the trapezoid exclusive of the square and the rectangle, and a pair of upper joints formed at outer side ends of the upper sleeper support in lateral symmetry;
a left fastener tightening the upper and lower joints provided on the left side;
a right fastener tightening the upper and lower joints provided on the right side; and
the left and right fasteners tightening up such that longitudinal directions of the left and right fasteners are in parallel to the trapezoidal slopes of the sleeper, respectively.

2. The safety equipment for preventing the buckling and shifting of the rails according to claim 1, wherein the lower fixing member comprises a rail creep prevention plate insertion space.

3. The safety equipment for preventing the buckling and shifting of the rails according to claim 1 or 2, further comprising a linking device to connect the safety equipment for preventing the buckling and shifting of the rails.

4. The safety equipment for preventing the buckling and shifting of the rails according to claim 3, in which the upper joint, comprising:

a joint piece holder;
a removable joint piece; and
said joint piece holder and said joint piece including
a linking device holder which has a serrated portion;
said linking device including
a joint bar which has serrated portions on both faces of the linking device; and
said linking device being sandwiched by the joint piece holder and the joint piece; and
said linking device being tightened by the left and right fasteners.

5. The safety equipment for preventing the buckling and shifting of the rails as in one of claims 1-4, wherein at least one set of the upper and lower joints provided on the left side and the upper and lower joints provided on the right side has the removable joint piece.

6. The safety equipment for preventing the buckling and shifting of the rails as in one of claims 1-5, in which said lower joint including a structure to prevent the left and right fasteners from falling off and loosening in which a fastener fall-off and looseness prevention fitting is used; and
said upper joint including a structure to prevent the left and right fasteners from loosening in which a fastener looseness prevention fitting is used.

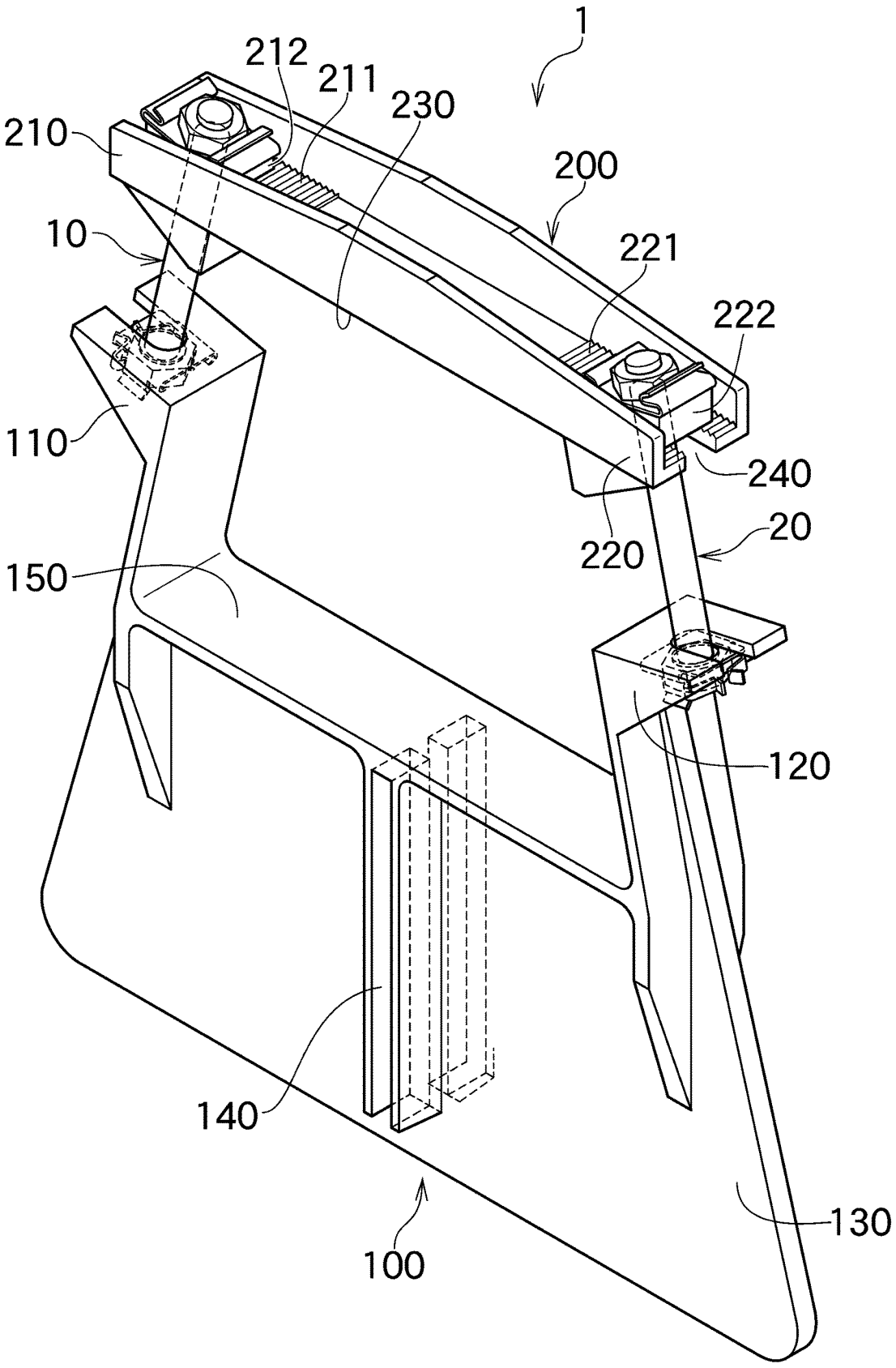
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Fig. 1

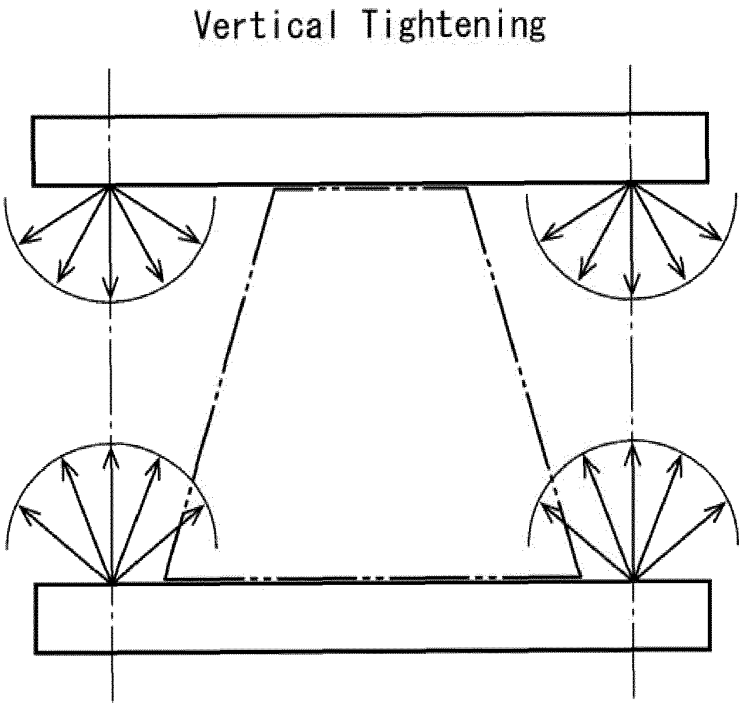


Fig. 2a

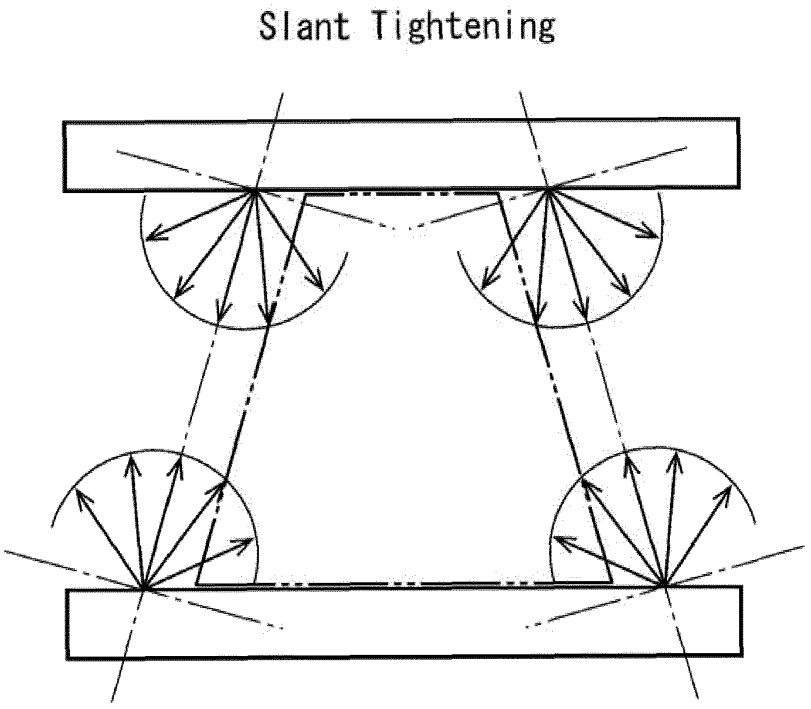


Fig. 2b

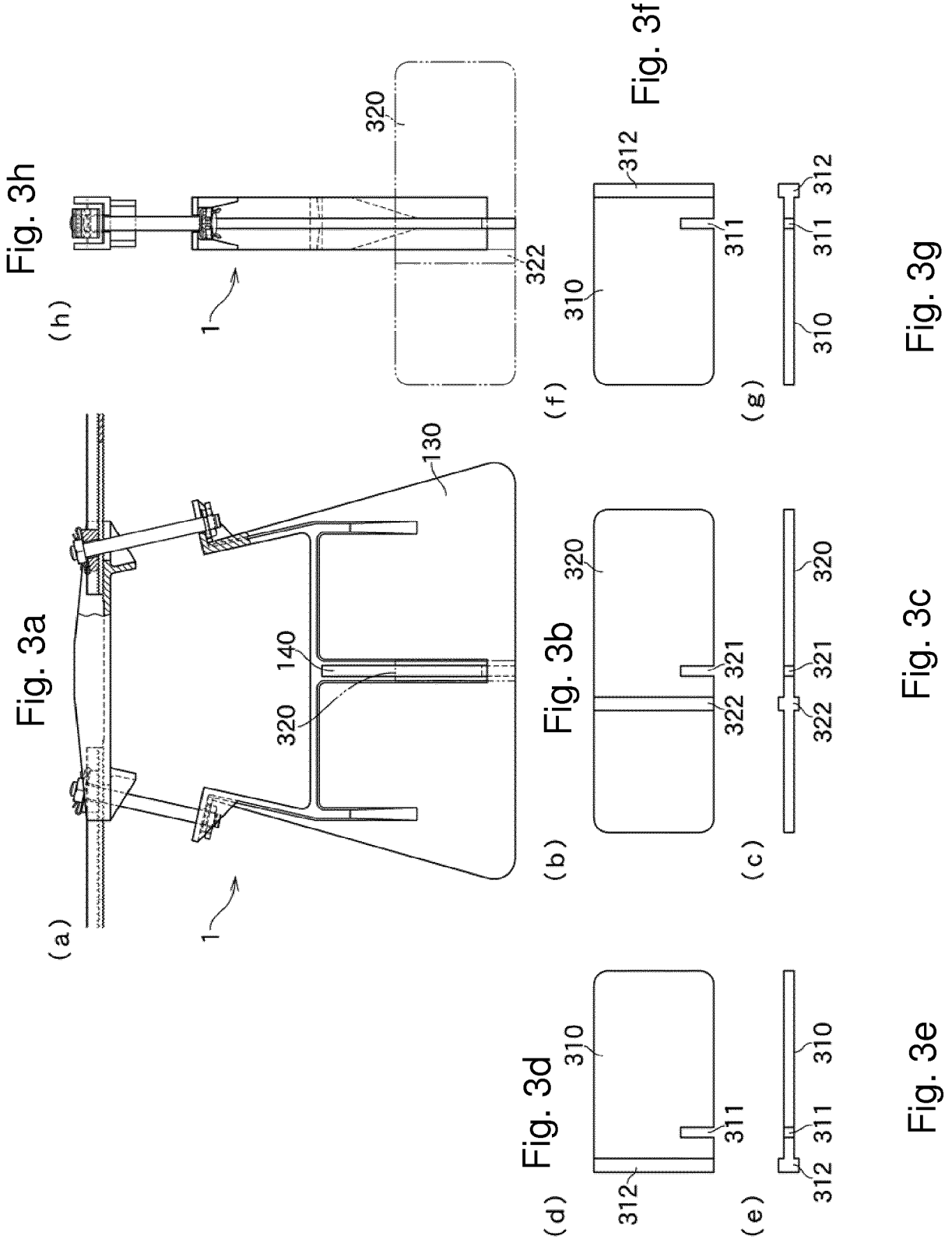


Fig. 3a

Fig. 3b

Fig. 3c

Fig. 3d

Fig. 3e

Fig. 3f

Fig. 3g

Fig. 3h

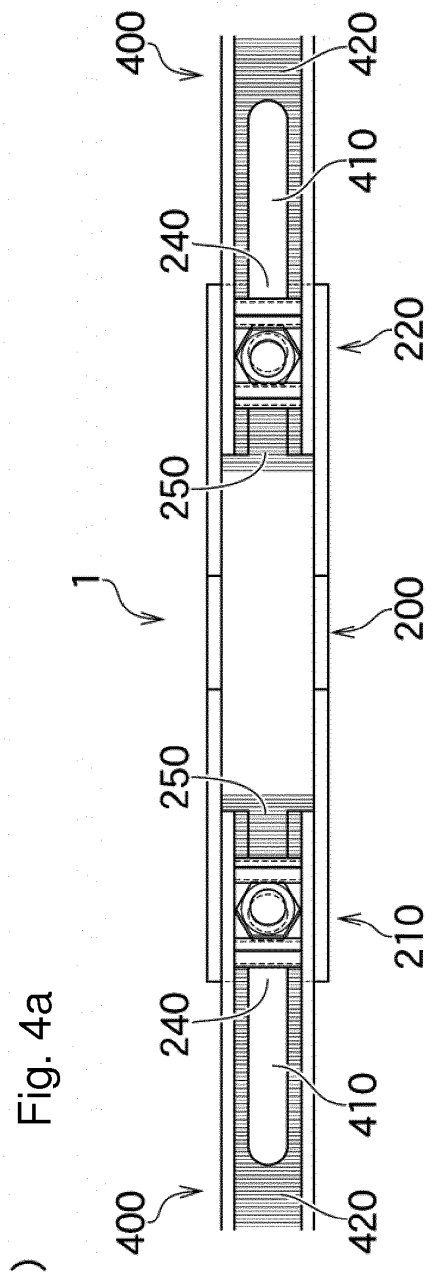


Fig. 4a

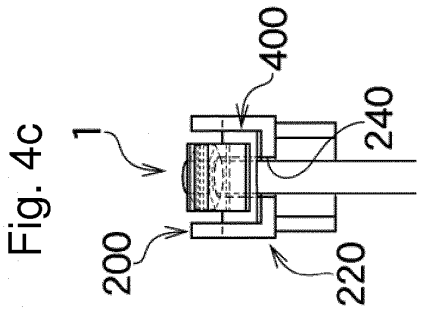


Fig. 4c

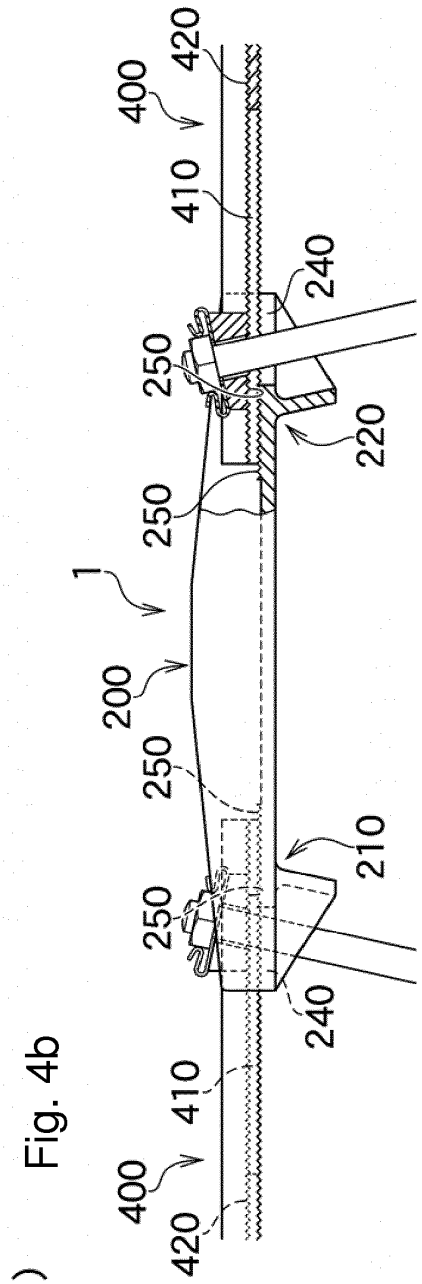


Fig. 4b

Fig. 5a

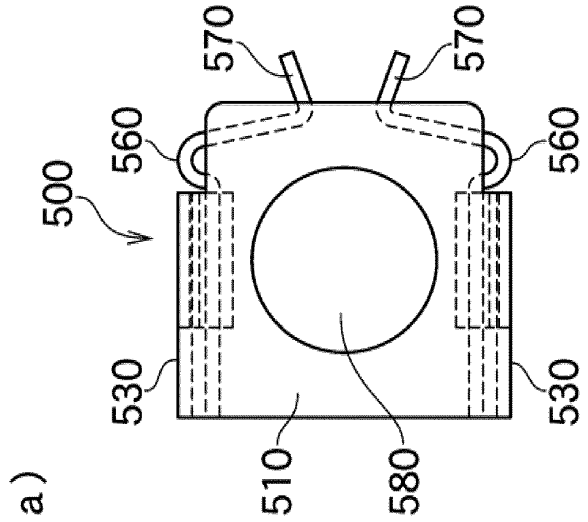


Fig. 5b

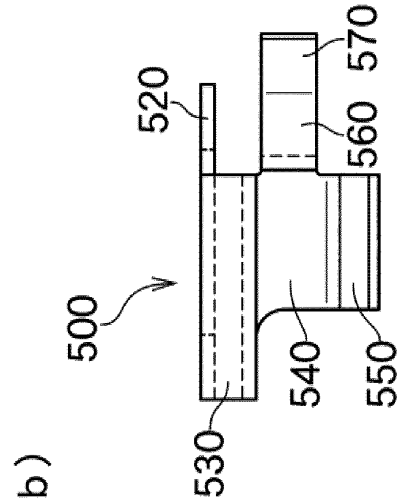


Fig. 5c

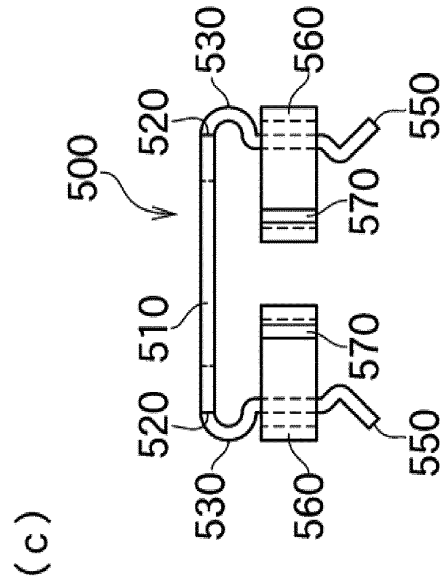
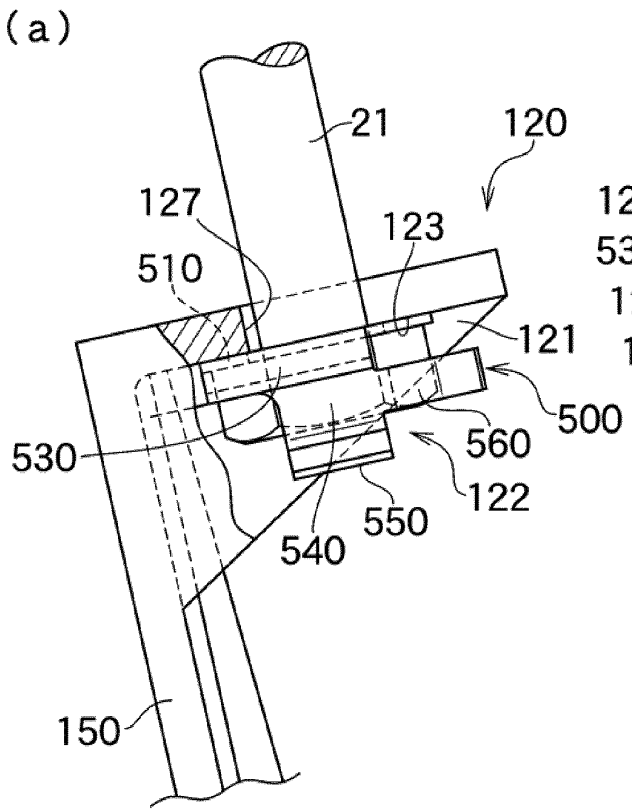


Fig. 6a



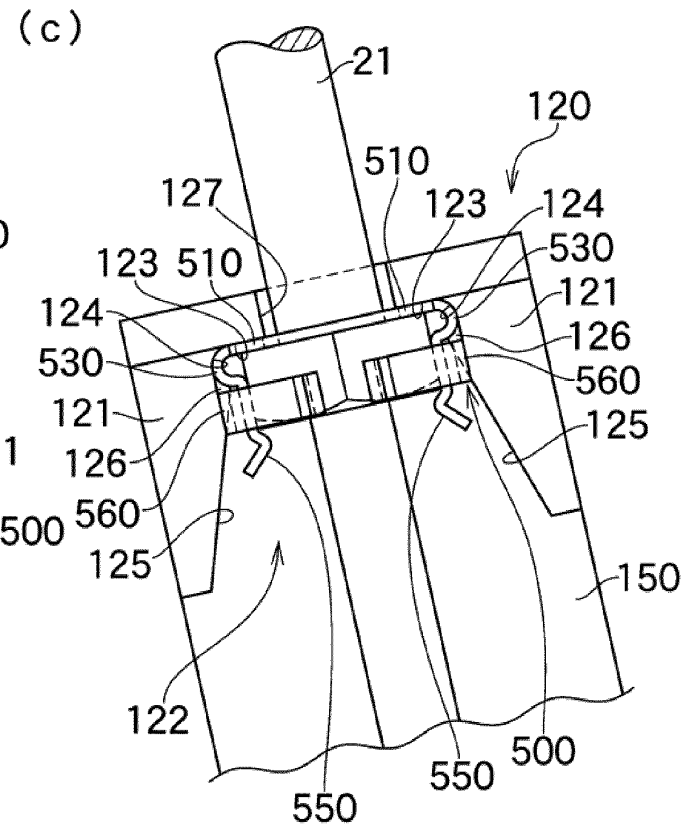


Fig. 6c

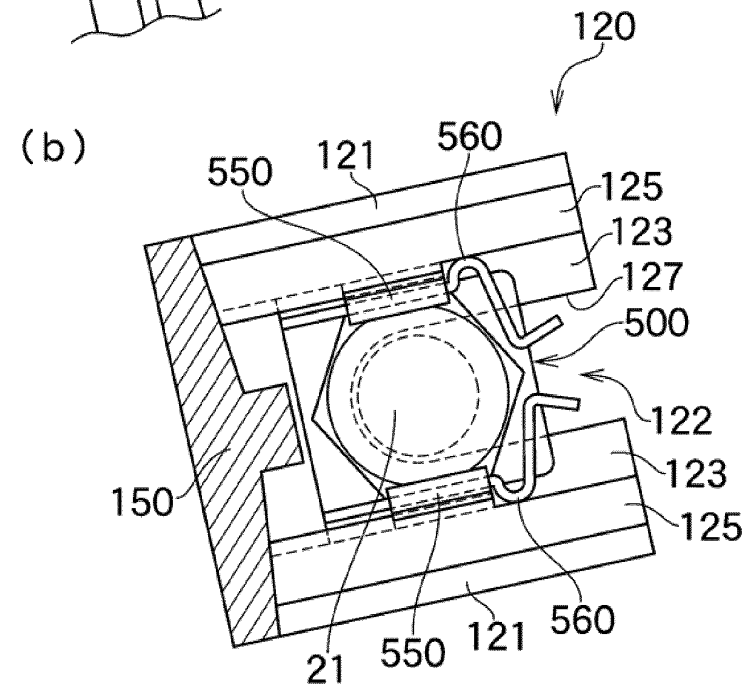


Fig. 6b

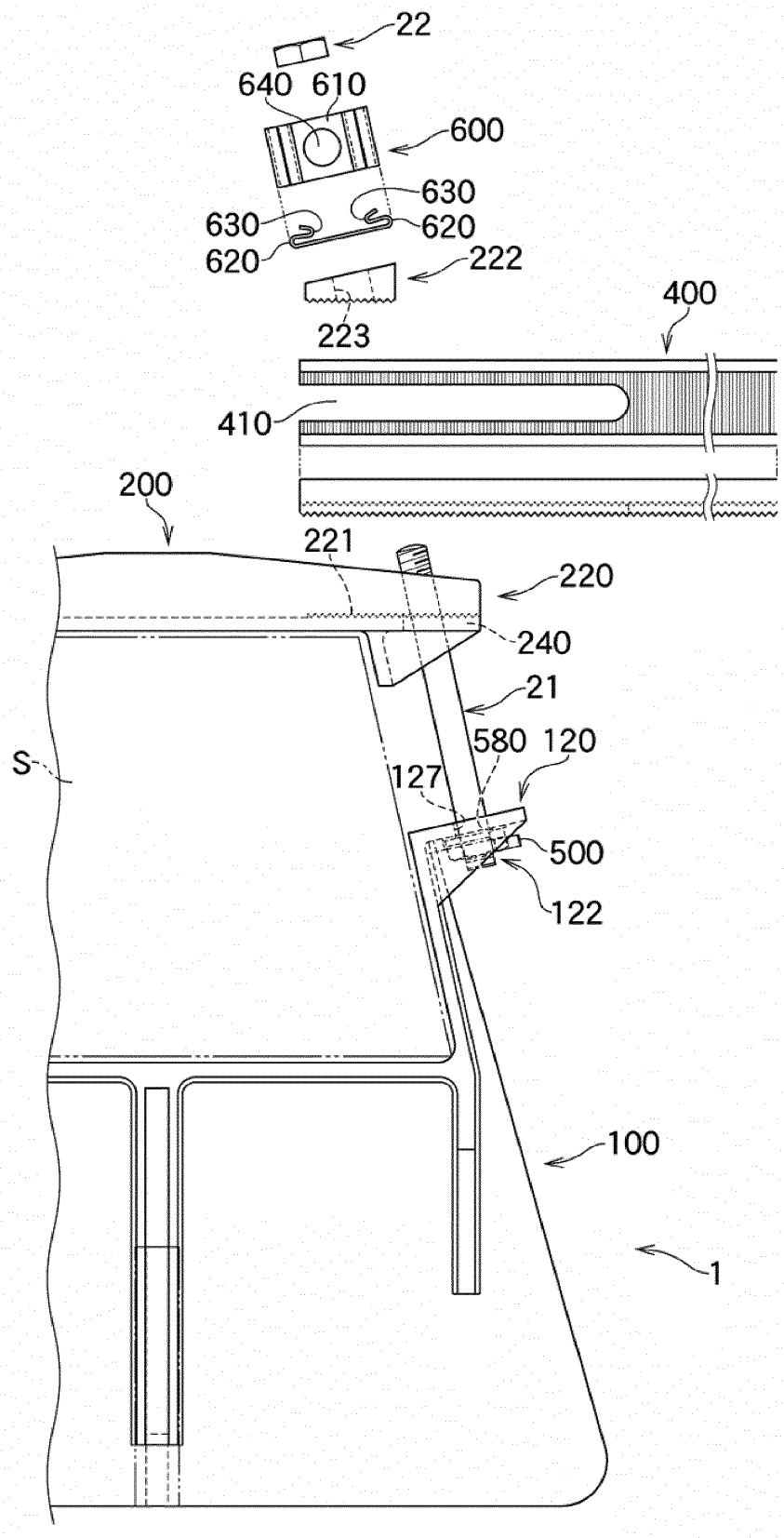

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Fig. 7

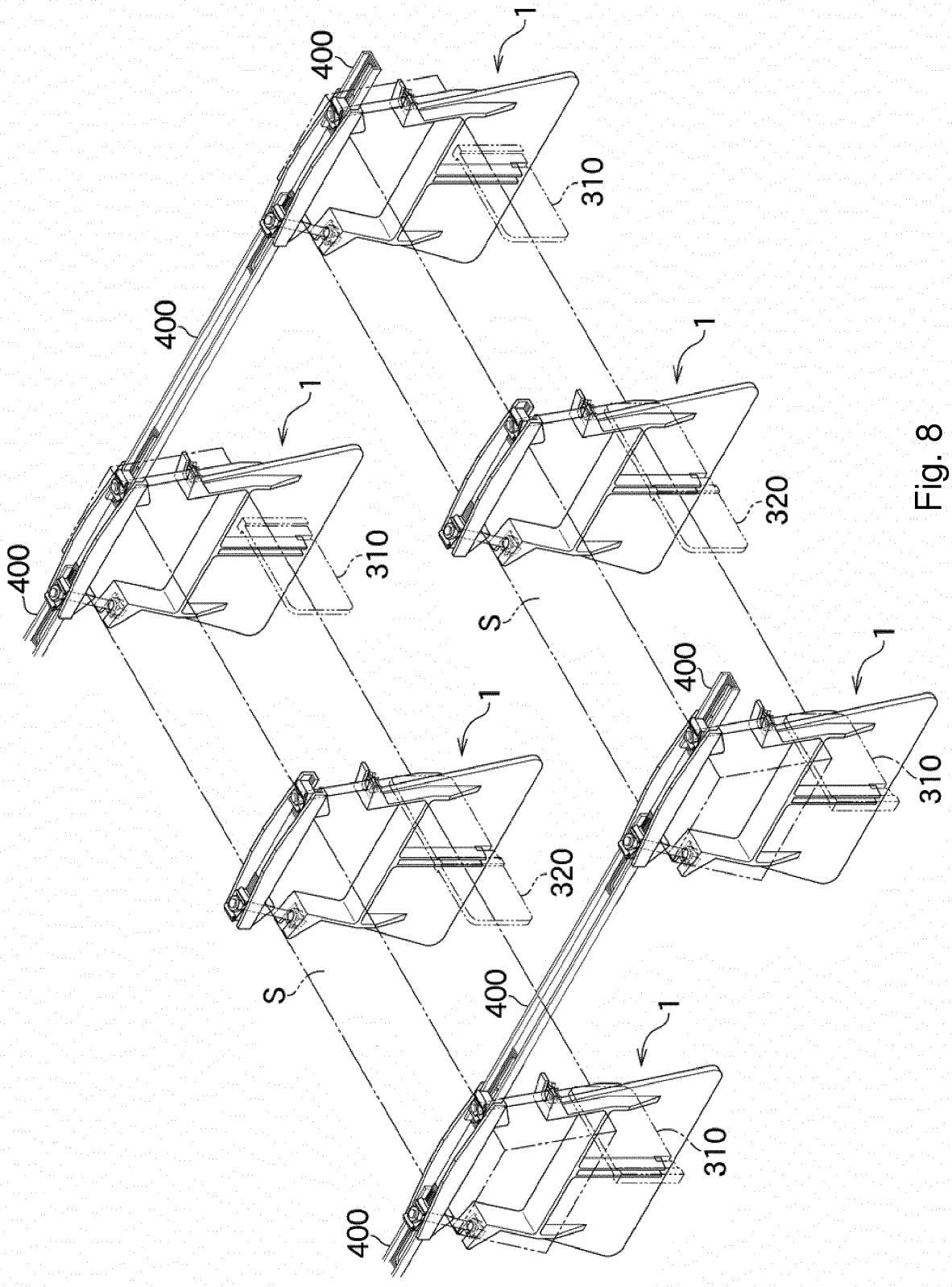

Fig. 8

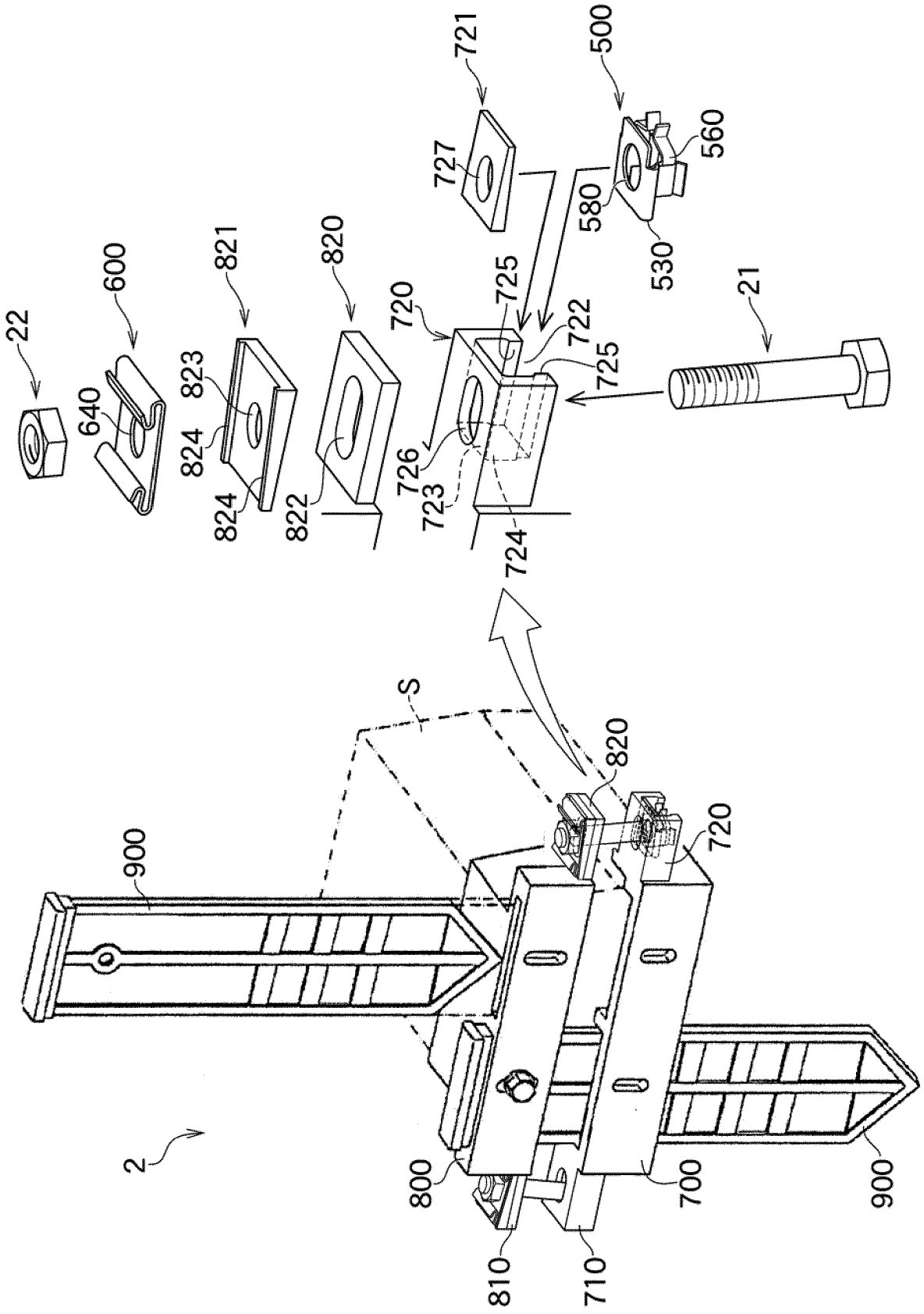
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Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/067351

A. CLASSIFICATION OF SUBJECT MATTER
E01B13/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E01B1/00-13/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3041957 U (Hayashi Soji Corp.), 16 July 1997 (16.07.1997), entire text (Family: none)	1-6
A	JP 2010-229642 A (Hayashi Soji Corp.), 14 October 2010 (14.10.2010), entire text & JP 4512661 B & KR 10-2010-0108180 A & TW 201104040 A	1-6

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 August 2016 (15.08.16)	30 August 2016 (30.08.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/067351

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 31370/1992(Laid-open No. 44529/1995) (West Japan Railway Co., Kabushiki Kaisha Mitsutekku), 21 November 1995 (21.11.1995), entire text (Family: none)	1-6
A	JP 8-13402 A (Central Japan Railway Co., Yamato Kogyo Co., Ltd.), 16 January 1996 (16.01.1996), entire text (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010229642 A **[0004]**
- JP 5641511 B **[0004]**