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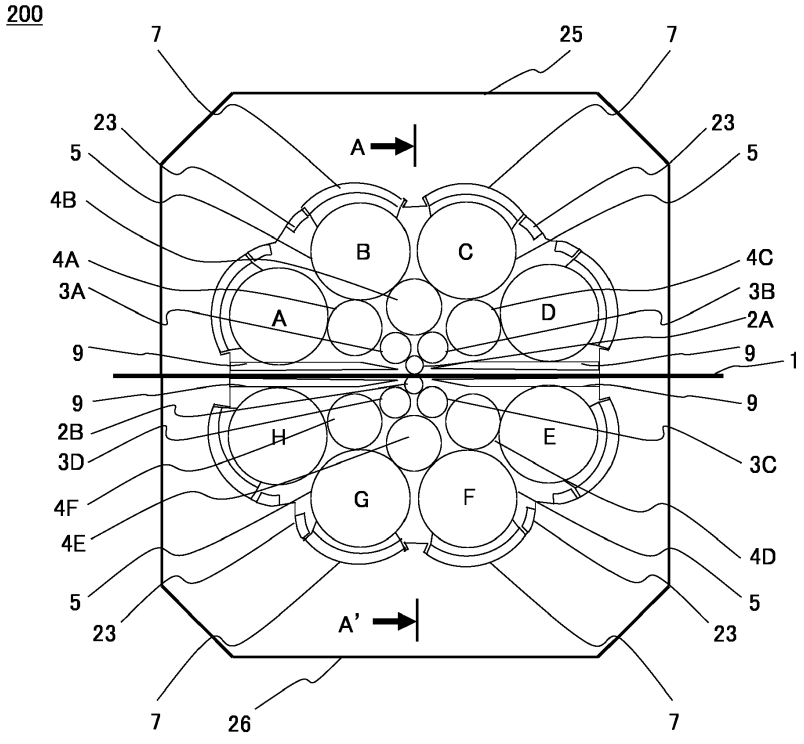
(54) ROLL REARRANGEMENT DEVICE AND ROLL REARRANGEMENT METHOD

(57) A roll rearrangement device 100 includes a carriage 110 that can travel in the axial directions of a second intermediate roll 4 and a backup roll 5 provided in a multi-high rolling mill 200, a support beam 130 that is provided so as to be movable with the travelling of the carriage 110 and taken in and out of the multi-high rolling mill 200, and two roll holding sections that are provided with an interval in the axial direction of the support beam 130 and can attach and detach the second intermediate roll 4 and the backup roll 5. This makes it possible to provide a roll rearrangement device and a roll rearrangement method that can improve the safety of rearrangement work as compared with conventional ones by realizing parallel insertion and extraction of rolls during roll rearrangement.

Fig 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a roll rearrangement device and a roll rearrangement method in a cluster-type rolling mill.

2. Description of the Related Art

[0002] FR-3122108-A1 describes a robotic system that is for a rolling facility for a metal strip and is suitable for performing operations involving replacement of rolling mill rolls by removing used rolls from a mill stand and depositing them on a laterally arranged rack, and/or inserting new or reconditioned rolls into the mill stand from rolls arranged in the rack.

SUMMARY OF THE INVENTION

[0003] In a cluster-type rolling mill, for example, as many as 20 rolls, as a set of upper and lower rolls, are housed in a space in a housing. Thus, in roll rearrangement (in the present specification, drawing and attaching of rolls from and to the rolling mill are collectively referred to as "rearrangement"), the rolls need to be rearranged in a limited space because the roll interval is short. In addition, risk is involved in rearrangement work of, in particular, heavy rolls such as second intermediate rolls and backup rolls.

[0004] Thus, for example, FR-3122108-A1 describes a robot that holds an end part (cylinder) of a roll to rearrange the roll.

[0005] However, in the technique of the above-described related art, a roll is supported on only a single side. That is, what is called a cantilever structure is made. Therefore, the amount of deflection of the roll is large, and work of horizontal insertion and extraction of rolls in the roll length direction becomes unstable., and close checking work increases. Accordingly, there is room for improvement in terms of safe rearrangement.

[0006] Moreover, particularly in rearrangement to a new roll, there is a case in which the roll is deflected and it is difficult to accurately fit the roll to a member that supports the roll on the housing side. In this case, there is a possibility that mill vibration occurs.

[0007] The present invention provides a roll rearrangement device and a roll rearrangement method that can improve the safety of rearrangement work as compared with conventional ones by realizing parallel insertion and extraction of rolls during roll rearrangement.

[0008] The present invention includes a plurality of means for solving the above-described problem. To cite one example thereof, a roll rearrangement device includes a carriage capable of travelling in an axial direction of a roll provided in a rolling mill, a support beam that is provided so as to be movable with travelling of the carriage and taken in and out of the rolling mill, and two roll holding sections that are provided with an interval in the axial direction of the support beam and are capable of attaching and detaching the roll.

[0009] According to the present invention, the safety of rearrangement work can be improved as compared with conventional ones by realizing parallel insertion and extraction of the roll during roll rearrangement. Problems, configurations, and effects other than the above-described ones will be made apparent by the following description of embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is a front view illustrating the outline of a multi-high rolling mill that is a target of roll replacement by a roll rearrangement device of an embodiment.

FIG. 2 is a diagram illustrating the outline of the roll rearrangement device of the embodiment.

FIG. 3 is a front view illustrating the state of the multi-high rolling mill in preparation for the start of replacement of rolls by the roll rearrangement device of the embodiment.

FIG. 4 is a front view illustrating the state where coolant spray headers before roll replacement are drawn by the roll rearrangement device of the embodiment.

FIG. 5 is an outline view illustrating the state in the multi-high rolling mill where the coolant spray headers before the roll replacement are drawn by the roll rearrangement device of the embodiment.

FIG. 6 is a front view illustrating the state of the multi-high rolling mill immediately before the start of the replacement of the rolls by the roll rearrangement device of the embodiment.

FIG. 7 is a front view illustrating the state where a upper second intermediate roll is drawn by the roll rearrangement device of the embodiment.

FIG. 8 is an outline view illustrating the state in the multi-high rolling mill where the upper second intermediate roll is drawn by the roll rearrangement device of the embodiment.

FIG. 9 is a front view illustrating the state where upper second intermediate drive rolls are drawn by the roll rearrangement device of the embodiment.

FIG. 10 is a front view illustrating the state where a lower second intermediate roll is drawn by the roll rearrangement device of the embodiment.

FIG. 11 is an outline view illustrating the state in the multi-high rolling mill where the lower second intermediate roll is drawn by the roll rearrangement device of the embodiment.

FIG. 12 is a front view illustrating the state where the lower second intermediate roll is drawn by the roll rearrangement device of the embodiment.

FIG. 13 is an outline view illustrating the state in the multi-high rolling mill where the lower second intermediate roll is drawn by the roll rearrangement device of the embodiment.

FIG. 14 is a front view illustrating the state where a lower second intermediate drive right roll is drawn by the roll rearrangement device of the embodiment.

FIG. 15 is a front view illustrating the state where a lower second intermediate drive left roll is drawn by the roll rearrangement device of the embodiment.

FIG. 16 is an outline view illustrating the state in the multi-high rolling mill where the lower second intermediate drive left roll is drawn by the roll rearrangement device of the embodiment.

FIG. 17 is a front view illustrating the state where the lower second intermediate drive left roll is drawn by the roll rearrangement device of the embodiment.

FIG. 18 is an outline view illustrating the state in the multi-high rolling mill where the lower second intermediate drive left roll is drawn by the roll rearrangement device of the embodiment.

FIG. 19 is a front view illustrating the state where a first lower backup roll E is drawn by the roll rearrangement device of the embodiment.

FIG. 20 is an outline view illustrating the state in the multi-high rolling mill where the first lower backup roll E is drawn by the roll rearrangement device of the embodiment.

FIG. 21 is a front view illustrating the state where a fourth lower backup roll H is drawn by the roll rearrangement device of the embodiment.

FIG. 22 is a front view illustrating the state where a second upper backup roll B and a third upper backup roll C are drawn by the roll rearrangement device of the embodiment.

FIG. 23 is a front view illustrating the state where a first upper backup roll A is drawn by the roll rearrangement device of the embodiment.

FIG. 24 is a diagram illustrating the outline of a holding structure for the backup roll in the multi-high rolling mill including a tile mechanism of an embodiment.

FIG. 25 is a diagram illustrating the outline when the holding structure for the backup roll in the multi-high rolling mill including the tile mechanism of the embodiment is viewed from another direction.

FIG. 26 is a diagram illustrating the outline of the tile mechanism of the embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Embodiments of a roll rearrangement device, a roll rearrangement method, and a tile according to the present invention will be described with use of FIGs. 1 to 26. Note that, in the drawings used in the present specification, the same or corresponding constituent elements are given the same or similar numerals, and repeated description is omitted regarding these constituent elements in some cases.

[0012] First, the overall configuration of a multi-high rolling mill 200 that is a target of roll replacement by a roll rearrangement device 100 of an embodiment will be described with use of FIG. 1. FIG. 1 illustrates the outline of the multi-high rolling mill 200 that is a target of roll replacement by the roll rearrangement device 100 of the embodiment.

[0013] As illustrated in FIG. 1, the multi-high rolling mill 200 of the present embodiment is a cluster-type 20-high rolling mill for rolling a metal strip 1, and is a rolling mill suitable for rolling of, in particular, hard materials such as a stainless steel strip, an electrical steel strip, and a copper alloy. Note that the multi-high rolling mill 200 does not need to be a 20-high rolling mill and a 12-high rolling mill can be employed.

[0014] In FIG. 1, the multi-high rolling mill 200 includes, as rolls, a pair of upper and lower work rolls 2 (upper work roll 2A and lower work roll 2B), two pairs of upper and lower first intermediate rolls 3 (upper first intermediate rolls 3A and 3B and lower first intermediate rolls 3C and 3D), three pairs of upper and lower second intermediate rolls 4 (upper second intermediate drive rolls 4A and 4C, upper second intermediate roll 4B, lower second intermediate drive right roll 4D, lower second intermediate roll 4E, and lower second intermediate drive left roll 4F), four pairs of upper and lower backup rolls 5 (first upper backup roll A, second upper backup roll B, third upper backup roll C, fourth upper backup roll D, first lower backup roll E, second lower backup roll F, third lower backup roll G, and fourth lower backup roll H) composed of split backing bearings 8, a shaft 6, and a tile 7, and so forth.

[0015] As illustrated in FIG. 1, the pair of upper and lower work rolls 2 roll the metal strip 1 that is a rolling target material.

[0016] The upper work roll 2A on the vertically upper side of the metal strip 1 is in contact with and supported by the upper first intermediate rolls 3A and 3B. The lower work roll 2B on the vertically lower side of the metal strip 1 is in contact with and supported by the lower first intermediate rolls 3C and 3D.

[0017] Furthermore, the upper first intermediate rolls 3A and 3B are in contact with and supported by the upper second intermediate drive roll 4A, the upper second intermediate roll 4B, and the upper second intermediate drive roll 4C. The lower first intermediate rolls 3C and 3D are in contact with and supported by the lower second intermediate drive right roll 4D, the lower second intermediate roll 4E, and the lower second intermediate drive left roll 4F. Note that "right" and "left" in the lower second intermediate drive right roll 4D and the lower second intermediate drive left roll 4F indicate a positional relationship in the plane of paper of FIG. 1 and actually "right" means the rolling direction side and "left" means the reverse direction side.

[0018] The upper second intermediate drive roll 4A, the upper second intermediate roll 4B, and the upper second

intermediate drive roll 4C located on the vertically upper side of the metal strip 1 among the three pairs of upper and lower second intermediate rolls 4 are in contact with and supported by the first upper backup roll A, the second upper backup roll B, the third upper backup roll C, and the fourth upper backup roll D located on the vertically upper side of the metal strip 1 among the backup rolls 5. Furthermore, the lower second intermediate drive right roll 4D, the lower second intermediate roll 4E, and the lower second intermediate drive left roll 4F located on the vertically lower side of the metal strip 1 are in contact with and supported by the first lower backup roll E, the second lower backup roll F, the third lower backup roll G, and the fourth lower backup roll H located on the vertically lower side of the metal strip 1 among the backup rolls 5.

[0019] These eight backup rolls 5 are each supported by an upper mill housing 25 or a lower mill housing 26 through the tile 7 thereof, and are each fixed to the upper mill housing 25 or the lower mill housing 26 by clamping action of a tile clamp 23. Note that the housing is not limited to the configuration formed of the upper mill housing 25 and the lower mill housing 26 divided vertically and may be a mono-block housing.

[0020] Moreover, for the multi-high rolling mill 200 of the present embodiment, the roll rearrangement device 100 as illustrated in FIG. 2 is provided on the work side of the upper mill housing 25 and the lower mill housing 26.

[0021] Next, the overall configuration of the roll rearrangement device 100 will be described with use of FIG. 2. The outline of the roll rearrangement device of the embodiment is illustrated in FIG. 2.

[0022] The roll rearrangement device 100 illustrated in FIG. 2 is a configuration that allows a support beam 130 to be inserted into the multi-high rolling mill 200, and includes a carriage 110, wheels 112, the support beam 130, roll holding sections 140, an X axis direction movable section 120, a Y axis direction movable section 122, a Z axis direction movable section 124, a header holding mechanism 180 (see FIGs. 4 and 5), and so forth.

[0023] In FIG. 2 and so forth, an X axis (orthogonal direction) is defined as the rolling direction of the multi-high rolling mill 200. A Y axis (axial direction) is defined as the axial direction of the work rolls 2, the first intermediate rolls 3, the second intermediate rolls 4, and the backup rolls 5 provided in the multi-high rolling mill 200. A Z axis (perpendicular direction) is defined as the direction perpendicular to a plane formed of the X axis direction and the Y axis direction.

[0024] A plurality of wheels 112 are provided on the bottom surface of the carriage 110. The carriage 110 can travel in the axial directions of the second intermediate rolls 4 and the backup rolls 5 provided in the multi-high rolling mill 200 by a configuration in which the wheels 112 travel on a rail disposed on the ground surface of a factory in which the multi-high rolling mill 200 is installed, or the like. Note that the carriage 110 may be capable of travelling in a direction other than the axial directions of the second intermediate rolls 4 and the backup rolls 5.

[0025] The support beam 130 is a beam that is provided so as to be movable with the travelling of the carriage 110 by, for example, being attached to a tip part of the Y axis direction movable section 122 on the drive side and is taken in and out of the multi-high rolling mill 200 by the Y axis direction movable section 122.

[0026] The two roll holding sections 140 are provided at an interval in the axial direction of the support beam 130, and have a structure that can attach and detach the second intermediate roll 4 and the backup roll 5.

[0027] These roll holding sections 140 are attachments (adapters) configured to be attachable and detachable to and from two places on the support beam 130 on the drive side and the work side, and have various shapes and mechanisms so as to be capable of holding both end parts of the six second intermediate rolls 4 in total and the eight backup rolls 5 in total in rearrangement work and capable of attaching and detaching the rolls to and from the multi-high rolling mill 200.

[0028] As described in detail later, the roll holding sections 140 include, for example, holding sections 150 for the upper second intermediate roll (see FIG. 7 and so forth), holding sections 154 for the upper second intermediate drive roll (see FIG. 9 and so forth), holding sections 158 for the lower second intermediate roll (see FIG. 10 and so forth), holding sections 162 for the lower second intermediate drive right roll (see FIG. 14), holding sections 166 for the lower second intermediate drive left roll (see FIG. 15 and so forth), holding sections 170 for the lower backup roll (see FIG. 19 and so forth), holding sections 174 for the upper backup roll (FIG. 23 and so forth), and so forth.

[0029] These holding sections 150 for the upper second intermediate roll, holding sections 154 for the upper second intermediate drive roll, holding sections 158 for the lower second intermediate roll, holding sections 162 for the lower second intermediate drive right roll, holding sections 166 for the lower second intermediate drive left roll, holding sections 170 for the lower backup roll, and holding sections 174 for the upper backup roll are each one set of attachments (adapters) formed of two members disposed on the drive side antecedently inserted into the multi-high rolling mill 200 in the support beam 130 and the work side closer to the Y axis direction movable section 122. Each of the two members has the same configuration.

[0030] The X axis direction movable section 120 is a part that adjusts the position of each of the roll holding sections 140 in the X axis direction with respect to the Y axis direction and the Z axis direction. The Y axis direction movable section 122 is a part that adjusts the axial direction position of each of the roll holding sections 140 in the Y axis direction. The Z axis direction movable section 124 is a part that adjusts the position of each of the roll holding sections 140 in the perpendicular direction.

[0031] These X axis direction movable section 120, Y axis direction movable section 122, and Z axis direction

movable section 124 are configured by a robotic arm that can move along three axes, for example. Note that, in order to allow parallel movement of the six second intermediate rolls 4 in total and the eight backup rolls 5 in total, specifications in which the allowable load is set to a value that allows these rolls to be sufficiently held are employed.

[0032] The header holding mechanism 180 is configured to be attachable and detachable to and from the support beam 130 alternatively with the roll holding sections 140, and is a configuration that can attach and detach a pair of upper and lower coolant spray headers 9 for spraying a coolant onto the front surface and back surface of the metal strip 1 rolled by the multi-high rolling mill 200. Details thereof will be described later.

[0033] FIG. 3 illustrates the state of the multi-high rolling mill in preparation for the start of replacement of rolls by the roll rearrangement device of the embodiment.

[0034] First, in the multi-high rolling mill 200 illustrated in FIG. 1, a space is opened between the upper mill housing 25 and the lower mill housing 26 by publicly-known various configurations, for example, hydraulic cylinders or the like provided at four corners on the upper surface of the upper mill housing 25. Thereafter, the pair of upper and lower work rolls 2 and the two pairs of upper and lower first intermediate rolls 3 are extracted from the side on which the roll rearrangement device 100 is disposed. Thereby, the initial state of drawing of rolls by the roll rearrangement device 100 of the present embodiment, illustrated in FIG. 3, is set.

[0035] Thereafter, roll replacement work by the roll rearrangement device 100 of the embodiment illustrated in FIG. 2 is started.

[0036] Description will be made below with reference to FIGs. 4 to 23 regarding the flow of a rearrangement method for the second intermediate rolls 4 and the backup rolls 5. In the rearrangement method, the carriage 110 that can travel in the axial directions of the second intermediate rolls 4 and the backup rolls 5 provided in the multi-high rolling mill 200 is equipped with the support beam 130 that is taken in and out of the multi-high rolling mill 200 and the two roll holding sections 140 that are provided with an interval in the axial direction of the support beam 130 and can attach and detach the second intermediate roll 4 and the backup roll 5. Furthermore, the roll holding sections 140 are inserted into the inside of the multi-high rolling mill 200 by the support beam 130 and hold the second intermediate roll 4 or the backup roll 5 as the replacement target to draw it from the multi-high rolling mill 200. Moreover, the support beam 130 is inserted into the inside of the multi-high rolling mill 200 in the state in which the second intermediate roll 4 or the backup roll 5 for replacement is held by the roll holding sections 140, and the second intermediate roll 4 or the backup roll 5 for replacement is attached to the multi-high rolling mill 200.

[0037] Description will be made below about the case in which (1) the coolant spray headers 9 are drawn and thereafter rolls are drawn in order of (2) the upper second intermediate drive roll 4A, the upper second intermediate roll 4B, and the upper second intermediate drive roll 4C, (3) the lower second intermediate drive right roll 4D, the lower second intermediate roll 4E, and the lower second intermediate drive left roll 4F, (4) the second lower backup roll F and the third lower backup roll G, (5) the first lower backup roll E and the fourth lower backup roll H, (6) the second upper backup roll B and the third upper backup roll C, and (7) the first upper backup roll A and the fourth upper backup roll D. However, the order of drawing the rolls is not limited to this order.

[0038] When the state illustrated in FIG. 3 has been obtained, first, the coolant spray headers 9 are drawn before drawing of the second intermediate rolls 4 and the backup rolls 5. It is desirable to ensure, by this drawing, a space for replacement work for the second intermediate rolls 4 and the backup rolls 5. FIGs. 4 and 5 illustrate the state where the coolant spray headers before roll replacement are drawn by the roll rearrangement device of the embodiment.

[0039] As illustrated in FIGs. 4 and 5, the header holding mechanism 180 has a upper fixing section 184 that fixes, at an upper part, the upper coolant spray header 9 to be attached or detached, and a lower fixing section 188 that fixes, at a lower part, the lower coolant spray header 9 to be attached or detached. First, this header holding mechanism 180 is attached to the support beam 130.

[0040] Thereafter, the carriage 110 of the roll rearrangement device 100 is moved to the vicinity of a side surface of the multi-high rolling mill 200. Then, as illustrated in FIG. 5, the X axis direction movable section 120, the Y axis direction movable section 122, and the Z axis direction movable section 124 are driven to insert the header holding mechanism 180 into the multi-high rolling mill 200 together with the support beam 130. In this state, the upper coolant spray header 9 fixed to the upper mill housing 25 is drawn to be fixed to the upper fixing section 184. In addition, the lower coolant spray header 9 fixed to the lower mill housing 26 is drawn to be fixed to the lower fixing section 188.

[0041] Thereafter, the coolant spray headers 9 are taken out by taking out the header holding mechanism 180 from the multi-high rolling mill 200 together with the support beam 130 through driving the X axis direction movable section 120, the Y axis direction movable section 122, and the Z axis direction movable section 124.

[0042] FIG. 6 illustrates the state of the multi-high rolling mill immediately before the start of replacement of rolls by the roll rearrangement device of the embodiment. Due to the completion of the work of FIGs. 4 and 5, the condition for the start of roll drawing (the work rolls 2, the first intermediate rolls 3, and the coolant spray headers 9 have been removed) is met.

[0043] FIGs. 7 and 8 illustrate the state where the upper second intermediate roll is drawn by the roll rearrangement device of the embodiment.

[0044] When the state of FIG. 6 has been obtained, first, the upper second intermediate roll 4B at the center with respect to the rolling direction among the upper second intermediate drive roll 4A, the upper second intermediate roll 4B, and the upper second intermediate drive roll 4C is drawn.

[0045] A lifting mechanism for the upper second intermediate roll 4B is turned off and, as illustrated in FIGs. 7 and 8, the holding sections 150 for the upper second intermediate roll exclusively for holding the upper second intermediate roll 4B are attached to the support beam 130 as the roll holding sections 140. Then, the Y axis direction movable section 122 and the Z axis direction movable section 124 are driven to insert the holding sections 150 for the upper second intermediate roll into a space directly under the upper second intermediate roll 4B together with the support beam 130.

[0046] Thereafter, the Z axis direction movable section 124 is driven to support both end parts of the upper second intermediate roll 4B from the lower side by the holding sections 150 for the upper second intermediate roll, and both end parts of the upper second intermediate roll 4B are held. Then, the Y axis direction movable section 122, the Z axis direction movable section 124, and the carriage 110 are driven to draw the upper second intermediate roll 4B from the inside of the multi-high rolling mill 200.

[0047] After the drawing of the upper second intermediate roll 4B, the upper second intermediate drive rolls 4A and 4C are drawn. FIG. 9 illustrates the state where the upper second intermediate drive rolls 4A and 4C are drawn by the roll rearrangement device of the embodiment.

[0048] First, the upper second intermediate roll 4B is removed from the holding sections 150 for the upper second intermediate roll, and the holding sections 150 for the upper second intermediate roll are detached from the support beam 130. Then, as illustrated in FIG. 9, the holding sections 154 for the upper second intermediate drive roll are attached to the support beam 130, and the Y axis direction movable section 122 and the Z axis direction movable section 124 are driven to insert the holding sections 154 for the upper second intermediate drive roll into a space directly under the upper second intermediate drive rolls 4A and 4C together with the support beam 130.

[0049] Thereafter, the Z axis direction movable section 124 is driven to support both end parts of the upper second intermediate drive rolls 4A and 4C from the lower side by the holding sections 154 for the upper second intermediate drive roll, and both end parts of the upper second intermediate drive rolls 4A and 4C are held. Moreover, in order to separate the upper second intermediate drive rolls 4A and 4C from a drive motor, a vibration function is turned on and a castellated coupling that connects the upper second intermediate drive rolls 4A and 4C to the drive motor is detached. Then, the Y axis direction movable section 122, the Z axis direction movable section 124, and the carriage 110 are driven to draw the upper second intermediate drive rolls 4A and 4C from the inside of the multi-high rolling mill 200.

[0050] After the drawing of the upper second intermediate drive rolls 4A and 4C, the lower second intermediate drive right roll 4D, the lower second intermediate roll 4E, and the lower second intermediate drive left roll 4F are drawn. Among these rolls, the lower second intermediate roll 4E is first drawn. FIGs. 10 and 13 illustrate the state where the lower second intermediate roll is drawn by the roll rearrangement device of the embodiment.

[0051] First, the upper second intermediate drive rolls 4A and 4C are removed from the holding sections 154 for the upper second intermediate drive roll, and the holding sections 154 for the upper second intermediate drive roll are detached from the support beam 130. Then, as illustrated in FIGs. 10 and 11, the holding sections 158 for the lower second intermediate roll each having a detachable hook that holds a neck of the lower second intermediate roll 4E from the lower side are attached to the support beam 130, and a lifting mechanism for the lower second intermediate roll 4E is turned off.

[0052] The hooks of the holding sections 158 for the lower second intermediate roll each have an inner circumferential part 159 that gets contact with part of the outer circumference of the neck, a rotation part 160 that rotates the inner circumferential part 159 in the circumferential direction, and a stopper 161 that stops the rotation of the rotation part 160 in the circumferential direction when the inner circumferential part 159 has been fitted to the neck.

[0053] As illustrated in FIGs. 10 and 11, these holding sections 158 for the lower second intermediate roll are inserted into an upper part of the center of the multi-high rolling mill 200 together with the support beam 130 by driving the Y axis direction movable section 122 and the Z axis direction movable section 124. Subsequently, the Z axis direction movable section 124 is driven to lower the support beam 130 from the upper part of the center of the multi-high rolling mill 200, and the hooks composed of the inner circumferential part 159, the rotation part 160, and the stopper 161 are inserted into spaces under the lower surfaces of the necks of the lower second intermediate roll 4E.

[0054] Thereafter, as illustrated in FIGs. 12 and 13, the rotation parts 160 are driven to rotate the inner circumferential parts 159, and the necks at both end parts of the lower second intermediate roll 4E are supported from the lower side by the inner circumferential parts 159. Then, the rotation of the rotation parts 160 in the circumferential direction is stopped by the stoppers 161 to make the state in which both end parts of the lower second intermediate roll 4E are held by the inner circumferential parts 159.

[0055] Thereafter, the Z axis direction movable section 124 is driven to raise the lower second intermediate roll 4E, and the Y axis direction movable section 122 and the carriage 110 are driven to draw the lower second intermediate roll 4E from the inside of the multi-high rolling mill

200.

[0056] Note that, although the configuration in which the Z axis direction movable section 124 is driven to lower and raise the support beam 130 has been illustrated, it is possible to employ a configuration in which the Z axis direction movable section 124 is not driven and the holding sections 158 for the lower second intermediate roll are lowered and raised with the support beam 130 kept as it is. This is the same also regarding the various roll holding sections 140 that have been described above and will be described later.

[0057] After the drawing of the lower second intermediate roll 4E, the lower second intermediate drive right roll 4D is drawn. FIG. 14 illustrates the state where the lower second intermediate drive right roll 4D is drawn by the roll rearrangement device of the embodiment.

[0058] First, the lower second intermediate roll 4E is removed from the holding sections 158 for the lower second intermediate roll, and the holding sections 158 for the lower second intermediate roll are detached from the support beam 130. Then, as illustrated in FIG. 14, the holding sections 162 for the lower second intermediate drive right roll each having a detachable hook that holds a neck of the lower second intermediate drive right roll 4D from the lower side are attached to the support beam 130. Then, the Y axis direction movable section 122 and the Z axis direction movable section 124 are driven to insert the holding sections 162 for the lower second intermediate drive right roll into a space somewhat closer to the rolling direction side relative to the center of the multi-high rolling mill 200 together with the support beam 130.

[0059] Similarly to the hooks of the holding sections 158 for the lower second intermediate roll, the hooks of the holding sections 162 for the lower second intermediate drive right roll also each have an inner circumferential part 163 that gets contact with part of the outer circumference of the neck, a rotation part 164 that rotates the inner circumferential part 163 in the circumferential direction, and a stopper 165 that stops the rotation of the rotation part 164 in the circumferential direction when the inner circumferential part 163 has been fitted to the neck.

[0060] Subsequently, the Z axis direction movable section 124 is driven to lower the support beam 130, and the hooks of the holding sections 162 for the lower second intermediate drive right roll are inserted into spaces under the lower surfaces of the necks at both end parts of the lower second intermediate drive right roll 4D.

[0061] Thereafter, the rotation parts 164 are driven to rotate the inner circumferential parts 163, and the necks at both end parts of the lower second intermediate drive right roll 4D are supported from the lower side by the inner circumferential parts 163. Then, the rotation of the rotation parts 164 in the circumferential direction is stopped by the stoppers 165 to make the state in which both end parts of the lower second intermediate drive right roll 4D are held by the inner circumferential parts 163.

[0062] Thereafter, in order to separate the lower second intermediate drive right roll 4D from a drive motor, a vibration function is turned on and a castellated coupling that connects the lower second intermediate drive right roll 4D to the drive motor is detached. Then, the Z axis direction movable section 124 is driven to raise the lower second intermediate drive right roll 4D, and the Y axis direction movable section 122 and the carriage 110 are driven to draw the lower second intermediate drive right roll 4D from the inside of the multi-high rolling mill 200.

[0063] After the drawing of the lower second intermediate drive right roll 4D, the lower second intermediate drive left roll 4F is drawn. FIGs. 15 and 18 illustrate the state where the lower second intermediate drive left roll 4F is drawn by the roll rearrangement device of the embodiment.

[0064] The lower second intermediate drive right roll 4D is removed from the holding sections 162 for the lower second intermediate drive right roll, and the holding sections 162 for the lower second intermediate drive right roll are detached from the support beam 130. Then, as illustrated in FIGs. 15 and 16, the holding sections 166 for the lower second intermediate drive left roll each having a detachable hook that holds a neck of the lower second intermediate drive left roll 4F from the lower side are attached to the support beam 130. Then, the Y axis direction movable section 122 and the Z axis direction movable section 124 are driven to insert the holding sections 166 for the lower second intermediate drive left roll into a space somewhat closer to the reverse direction side relative to the center of the multi-high rolling mill 200 together with the support beam 130.

[0065] The hooks of the holding sections 166 for the lower second intermediate drive left roll each have an anti-tumbling mechanism for the lower second intermediate drive left roll 4F. For example, the anti-tumbling mechanism is composed of a flat plate part 168 that holds the neck from the lower side and a wall part 167 that holds the neck from a lateral side, and the angle formed by these flat plate part 168 and wall part 167 is an acute angle. The anti-tumbling mechanism is not limited to this configuration, and can employ an electromagnet that holds the neck by a magnetic force, a structure that causes suction adhesion of the neck, a concavity and a convexity that are each present in the neck or on the side of the holding section 166 for the lower second intermediate drive left roll and are fitted to each other, and the like.

[0066] Subsequently, the X axis direction movable section 120 is driven to insert the flat plate parts 168 into spaces under the lower surfaces of the necks at both end parts of the lower second intermediate drive left roll 4F, and the Z axis direction movable section 124 is driven to lift up the necks of the lower second intermediate drive left roll 4F.

[0067] Thereafter, in order to separate the lower second intermediate drive left roll 4F from a drive motor, a vibration function is turned on and a castellated coupling that connects the lower second intermediate drive left roll

4F to the drive motor is detached. Then, the Y axis direction movable section 122 and the carriage 110 are driven to draw the lower second intermediate drive left roll 4F from the inside of the multi-high rolling mill 200.

[0068] Note that, although the example in which the lower second intermediate drive right roll 4D is drawn earlier than the lower second intermediate drive left roll 4F has been illustrated, it is also possible to first draw the lower second intermediate drive left roll 4F by using attachments with a structure similar to that of the holding sections 162 for the lower second intermediate drive right roll and thereafter draw the lower second intermediate drive right roll 4D by using attachments with a structure similar to that of the holding sections 166 for the lower second intermediate drive left roll.

[0069] After the drawing of all of the second intermediate rolls 4, the backup rolls 5 are drawn. Among the eight backup rolls 5, first the second lower backup roll F and the third lower backup roll G are drawn.

[0070] These second lower backup roll F and third lower backup roll G are drawn in the same manner as the drawing of the lower second intermediate roll 4E by use of the holding sections 158 for the lower second intermediate roll, illustrated in the above-described FIGs. 10 to 13. Regarding the order of drawing of the second lower backup roll F and the third lower backup roll G, either roll may be drawn earlier.

[0071] After the drawing of the second lower backup roll F and the third lower backup roll G, the first lower backup roll E and the fourth lower backup roll H are drawn. Here, the first lower backup roll E is drawn earlier. FIGs. 19 and 20 illustrate the state where the first lower backup roll E is drawn by the roll rearrangement device of the embodiment.

[0072] First, the second lower backup roll F or the third lower backup roll G is removed from the holding sections 158 for the lower second intermediate roll, and the holding sections 158 for the lower second intermediate roll are detached from the support beam 130. Then, as illustrated in FIGs. 19 and 20, the holding sections 170 for the lower backup roll each having a detachable hook that holds a neck of the first lower backup roll E or the fourth lower backup roll H from the lower side are attached to the support beam 130. Then, the Y axis direction movable section 122 and the Z axis direction movable section 124 are driven to insert the holding sections 170 for the lower backup roll into the center of the lower mill housing 26 together with the support beam 130.

[0073] These holding sections 170 for the lower backup roll can be provided with the hooks each having an inner circumferential part that gets contact with part of the outer circumference of the neck, a rotation part that rotates the inner circumferential part in the circumferential direction, and a stopper that stops the rotation of the rotation part in the circumferential direction when the inner circumferential part has been fitted to the neck, similarly to the hooks of the above-described holding sections 158 for the lower second intermediate roll and holding sections 162 for the lower second intermediate drive right roll.

[0074] Thereafter, the X axis direction movable section 120 and the Z axis direction movable section 124 are driven to support both end parts of the first lower backup roll E from the lower side by the holding sections 170 for the lower backup roll, and both end parts are held. Then, the Y axis direction movable section 122 and the carriage 110 are driven to draw the first lower backup roll E from the inside of the multi-high rolling mill 200.

[0075] After the drawing of the first lower backup roll E, the fourth lower backup roll H is drawn. FIG. 21 illustrates the state where the fourth lower backup roll H is drawn by the roll rearrangement device of the embodiment.

[0076] First, after the first lower backup roll E is removed from the holding sections 170 for the lower backup roll, the holding sections 170 for the lower backup roll are inverted while remaining attached to the support beam 130. Then, as illustrated in FIG. 21, the holding sections 170 for the lower backup roll are inserted into the center of the lower mill housing 26 together with the support beam 130 by driving the Y axis direction movable section 122 and the Z axis direction movable section 124 again.

[0077] Thereafter, the X axis direction movable section 120 and the Z axis direction movable section 124 are driven to support both end parts of the fourth lower backup roll H from the lower side by the holding sections 170 for the lower backup roll, and both end parts are held. Then, the Y axis direction movable section 122 and the carriage 110 are driven to draw the fourth lower backup roll H from the inside of the multi-high rolling mill 200.

[0078] Note that a configuration in which the fourth lower backup roll H is drawn earlier than the first lower backup roll E may be employed although the example in which the first lower backup roll E is drawn earlier has been described.

[0079] After the drawing of all of the backup rolls 5 on the lower side, the first upper backup roll A, the second upper backup roll B, the third upper backup roll C, and the fourth upper backup roll D are drawn. Among the backup rolls 5 on the upper side, first the second upper backup roll B and the third upper backup roll C are drawn. FIG. 22 illustrates the state where the second upper backup roll B and the third upper backup roll C are drawn by the roll rearrangement device of the embodiment.

[0080] As illustrated in FIG. 22, these second upper backup roll B and third upper backup roll C are drawn in the same manner as the drawing of the upper second intermediate drive rolls 4A and 4C by use of the holding sections 154 for the upper second intermediate drive roll, illustrated in the above-described FIG. 9. Regarding the order of drawing of the second upper backup roll B and the third upper backup roll C, either roll may be drawn earlier.

[0081] After the drawing of the second upper backup roll B and the third upper backup roll C, the first upper backup roll A and the fourth upper backup roll D are drawn. Here, the first upper backup roll A is drawn earlier.

FIG. 23 illustrates the state where the first upper backup roll A is drawn by the roll rearrangement device of the embodiment.

[0082] First, the second upper backup roll B and the third upper backup roll C are removed from the holding sections 154 for the upper second intermediate drive roll, and the holding sections 154 for the upper second intermediate drive roll are detached from the support beam 130. Then, as illustrated in FIG. 23, the holding sections 174 for the upper backup roll each having a detachable hook that holds a neck of the first upper backup roll A or the fourth upper backup roll D from the lower side are attached to the support beam 130. Then, the Y axis direction movable section 122 and the Z axis direction movable section 124 are driven to insert the holding sections 174 for the upper backup roll into the center of the upper mill housing 25 together with the support beam 130.

[0083] These holding sections 174 for the upper backup roll can be provided with the hooks each having an inner circumferential part that gets contact with part of the outer circumference of the neck, a rotation part that rotates the inner circumferential part in the circumferential direction, and a stopper that stops the rotation of the rotation part in the circumferential direction when the inner circumferential part has been fitted to the neck, similarly to the hooks of the above-described holding sections 158 for the lower second intermediate roll, holding sections 162 for the lower second intermediate drive right roll, and holding sections 170 for the lower backup roll.

[0084] Thereafter, the X axis direction movable section 120 and the Z axis direction movable section 124 are driven to support both end parts of the first upper backup roll A from the lower side by the holding sections 174 for the upper backup roll, and both end parts are held. Then, the Y axis direction movable section 122 and the carriage 110 are driven to draw the first upper backup roll A from the inside of the multi-high rolling mill 200. After the drawing of the first upper backup roll A, the fourth upper backup roll D is drawn.

[0085] First, after the first upper backup roll A is removed from the holding sections 174 for the upper backup roll, the holding sections 174 for the upper backup roll are inverted while remaining attached to the support beam 130. Then, the holding sections 174 for the upper backup roll are inserted into the center of the upper mill housing 25 together with the support beam 130 by driving the Y axis direction movable section 122 and the Z axis direction movable section 124 again.

[0086] Thereafter, the X axis direction movable section 120 and the Z axis direction movable section 124 are driven to support both end parts of the fourth upper backup roll D from the lower side by the holding sections 174 for the upper backup roll, and both end parts are held. Then, the Y axis direction movable section 122 and the carriage 110 are driven to draw the fourth upper backup roll D from the inside of the multi-high rolling mill 200.

[0087] Note that a configuration in which the fourth upper backup roll D is drawn earlier than the first upper backup roll A may be employed although the example in which the first upper backup roll A is drawn earlier has been described.

[0088] It is desirable that the procedure of attaching the backup rolls 5, the second intermediate rolls 4, the first intermediate rolls 3, and the work rolls 2 be set opposite to the procedure of the above-described FIGs. 4 to 23.

[0089] That is, it is desirable to attach the rolls in order of (1) the first upper backup roll A and the fourth upper backup roll D, (2) the second upper backup roll B and the third upper backup roll C, (3) the first lower backup roll E and the fourth lower backup roll H, (4) the second lower backup roll F and the third lower backup roll G, (5) the lower second intermediate drive right roll 4D, the lower second intermediate roll 4E, and the lower second intermediate drive left roll 4F, and (6) the upper second intermediate drive roll 4A, the upper second intermediate roll 4B, and the upper second intermediate drive roll 4C. Furthermore, it is desirable to attach (7) the coolant spray headers 9 after the attaching of all of the second intermediate rolls 4 and the backup rolls 5 for replacement.

[0090] The attaching is executed in the procedure opposite to that of the drawing by using the various roll holding sections 140 used in the drawing, and therefore description of details of the attaching procedure is omitted.

[0091] FIG. 24 illustrates the outline of a holding structure for the backup roll in the multi-high rolling mill including a tile mechanism of an embodiment. FIG. 25 illustrates the outline when the holding structure for the backup roll in the multi-high rolling mill including the tile mechanism of the embodiment is viewed from another direction. FIG. 26 illustrates the outline of the tile mechanism of the embodiment.

[0092] Here, in the multi-high rolling mill 200, when the backup rolls 5 are replaced, the tiles 7 that fix the backup rolls 5 to the upper mill housing 25 or the lower mill housing 26 need to be drawn from the upper mill housing 25 or the lower mill housing 26 in advance before these backup rolls 5 are drawn. Similarly, also when being attached, the backup rolls 5 need to be fixed to the upper mill housing 25 or the lower mill housing 26 by the tiles 7 at last.

[0093] This drawing and attaching work of the tiles 7 is work that requires access to the backup rolls 5 in the state in which these backup rolls 5, which are heavy objects, are not fixed. Therefore, the work needs to be executed vary carefully. Accordingly, the need for making the work easier is very high.

[0094] Thus, as illustrated in FIGs. 24 to 26, it is possible to employ, as a tile 7A for fixing the backup roll 5 to the multi-high rolling mill 200, a structure including a tile main part 7A1 with such a plate shape as to be movable in the axial direction of the backup roll 5 and an engagement part 7A2 that engages with a tile clamp 23A that restrains the movement of the tile main part 7A1 in the axial

direction.

[0095] In such a tile 7A, preferably, the engagement part 7A2 is formed on an end part side of the tile main part 7A1. Moreover, it is desirable that the tile main part 7A1 be made into a trapezoidal shape in which the side antecedently inserted into the multi-high rolling mill 200 in the axial direction is the top base or the bottom base, that is, a tapered structure, and be configured in such a manner that the position of the tile main part 7A1 is settled when the tile main part 7A1 is pushed into the multi-high rolling mill 200.

[0096] Next, effects of the present embodiment will be described.

[0097] The roll rearrangement device 100 of the above-described present embodiment includes the carriage 110 that can travel in the axial directions of the second intermediate rolls 4 and the backup rolls 5 provided in the multi-high rolling mill 200, the support beam 130 that is provided so as to be movable with the travelling of the carriage 110 and taken in and out of the multi-high rolling mill 200, and the two roll holding sections that are provided with an interval in the axial direction of the support beam 130 and can attach and detach the second intermediate roll 4 and the backup roll 5.

[0098] Furthermore, in the rearrangement method for the second intermediate rolls 4 and the backup rolls 5, the carriage 110 that can travel in the axial directions of the second intermediate rolls 4 and the backup rolls 5 provided in the multi-high rolling mill 200 is equipped with the support beam 130 that is taken in and out of the multi-high rolling mill 200 and the two roll holding sections that are provided with an interval in the axial direction of the support beam 130 and can attach and detach the second intermediate roll 4 and the backup roll 5. Moreover, the roll holding sections are inserted into the inside of the multi-high rolling mill 200 by the support beam 130 and hold the second intermediate roll 4 or the backup roll 5 as the replacement target to draw it from the multi-high rolling mill 200. Furthermore, the support beam 130 is inserted into the inside of the multi-high rolling mill 200 in the state in which the second intermediate roll 4 or the backup roll 5 for replacement is held by the roll holding sections, and the second intermediate roll 4 or the backup roll 5 for replacement is attached to the multi-high rolling mill 200.

[0099] In this manner, both end parts of the roll as the rearrangement target are held by the two roll holding sections provided with an interval in the axial direction of the support beam 130. Due to this, the roll can be stably supported with small deflection of the roll. Thus, moving the roll in parallel during roll rearrangement can be executed very easily as compared with conventional configurations. Therefore, check work and the like can be reduced as compared with the conventional configurations, and thus the safety of the roll rearrangement can be improved.

[0100] Furthermore, the roll rearrangement device 100 further includes the Y axis direction movable section 122 that adjusts the axial direction position of each of the roll holding sections in the axial direction. Therefore, although the length is different for each roll, it is possible to simply deal with the difference. Accordingly, automatic replacement of rolls with various lengths can be realized.

[0101] Moreover, the roll holding sections further have the detachable hook that holds the neck of the second intermediate roll 4 or the backup roll 5 from the lower side. Due to this, in work of drawing or attaching the roll, the work can be executed with the roll held more stably. Thus, further improvement in the work efficiency can be achieved while further improvement in the safety is allowed.

[0102] Furthermore, the roll rearrangement device 100 further includes the Z axis direction movable section 124 that adjusts the position of each of the roll holding sections in the perpendicular direction and the X axis direction movable section 120 that adjusts the position of each of the roll holding sections in the orthogonal direction to the axial direction and the perpendicular direction. In addition, the hooks have the inner circumferential part that gets contact with part of the outer circumference of the neck, the rotation part that rotates the inner circumferential part in the circumferential direction, and the stopper that stops the rotation of the rotation part in the circumferential direction when the inner circumferential part has been fitted to the neck. Due to this, also when the roll holding sections 140 make access from the upper side of the roll, the roll can be drawn or attached with the necks at both ends of the roll stably held.

[0103] Moreover, the roll rearrangement device 100 further includes the Z axis direction movable section 124 that adjusts the position of each of the roll holding sections in the perpendicular direction and the X axis direction movable section 120 that adjusts the position of each of the roll holding sections in the orthogonal direction to the axial direction and the perpendicular direction. In addition, the hooks have the anti-tumbling mechanism for the second intermediate rolls 4 and the backup rolls 5. Due to this, when access is possible from a lateral side of the roll, rearrangement work can be executed with the necks of the roll held firmly and stably.

[0104] Furthermore, the roll holding sections are configured to be attachable and detachable to and from the support beam 130. Due to this, when the workspace is different for each roll, the rolls as the automatic replacement target can be increased by preparing the roll holding sections 140 with various structures. Thus, roll rearrangement work can be executed more stably.

[0105] Moreover, the roll rearrangement device 100 further includes the header holding mechanism 180 that is configured to be attachable and detachable to and from the support beam 130 and can attach and detach the pair of upper and lower coolant spray headers 9 for spraying a coolant onto the front surface and back surface of the metal strip 1 rolled by the multi-high rolling mill 200. The header holding mechanism 180 has the upper fixing section 184 that fixes, at an upper part, the upper coolant

spray header 9 to be attached or detached and the lower fixing section 188 that fixes, at a lower part, the lower coolant spray header 9 to be attached or detached. This allows automatic replacement also for the coolant spray headers 9.

[0106] Furthermore, when the multi-high rolling mill 200 is a 20-high rolling mill, the rolls are drawn in order of: the upper second intermediate drive roll 4A, the upper second intermediate roll 4B, and the upper second intermediate drive roll 4C; the lower second intermediate drive right roll 4D, the lower second intermediate roll 4E, and the lower second intermediate drive left roll 4F; the second lower backup roll F and the third lower backup roll G; the first lower backup roll E and the fourth lower backup roll H; the second upper backup roll B and the third upper backup roll C; and the first upper backup roll A and the fourth upper backup roll D. This allows work with gradual increase in the workspace. Therefore, more stable drawing work can be achieved.

[0107] Moreover, the coolant spray headers 9 are drawn before drawing of the second intermediate rolls 4 and the backup rolls 5 as the replacement target. This allows work with further enlargement of the workspace.

[0108] Furthermore, when the multi-high rolling mill 200 is a 20-high rolling mill, the rolls are attached in order of: the first upper backup roll A and the fourth upper backup roll D; the second upper backup roll B and the third upper backup roll C; the first lower backup roll E and the fourth lower backup roll H; the second lower backup roll F and the third lower backup roll G; the lower second intermediate drive right roll 4D, the lower second intermediate roll 4E, and the lower second intermediate drive left roll 4F; and the upper second intermediate drive roll 4A, the upper second intermediate roll 4B, and the upper second intermediate drive roll 4C. Due to this, the backup rolls 5, which are the heaviest, can be attached from a stage where the workspace has room. Therefore, the stability of work can be further enhanced.

[0109] Moreover, the coolant spray headers 9 are attached after attaching of all of the second intermediate rolls 4 and the backup rolls 5 for replacement. This can avoid reduction in the workspace due to the coolant spray headers 9.

<Others>

[0110] Note that the present invention is not limited to the above-described embodiments and various modifications and applications are possible. The above-described embodiments are described in detail in order to explain the present invention in an easy-to-understand manner and are not necessarily limited to that including all configurations described.

[0111] For example, in the multi-high rolling mill, when the upper backup rolls and the lower backup rolls are replaced, the tiles that fix the upper backup rolls and the lower backup rolls to the housing need to be drawn from the housing of the rolling mill in advance before these backup rolls are drawn. Similarly, also when being attached, the backup rolls need to be fixed to the housing by the tiles.

[0112] This drawing and attaching work of the tiles is work that requires access to the upper backup rolls and the lower backup rolls in the state in which these backup rolls, which are heavy objects, are not fixed. Therefore, the work needs to be executed vary carefully. Accordingly, the need for making the work easier is very high.

[0113] Thus, for example, as another aspect of the present invention, the following aspect is employed in order to provide a tile and a rolling mill including a tile that can reduce the burden of a worker in rearrangement work of upper backup rolls and lower backup rolls as compared with conventional ones.

(1) A tile for fixing a upper backup roll and a lower backup roll to a rolling mill, the tile including a tile main part with such a plate shape as to be movable in the axial direction of the upper backup roll and the lower backup roll and an engagement part that engages with a tile clamp that restrains the movement of the tile main part in the axial direction. With such a tile, when the upper backup roll and the lower backup roll are extracted from the rolling mill in order to fix them or when they are inserted into the rolling mill, the upper backup roll and the lower backup roll are easily inserted because being guided by a flat surface. Therefore, the burden of the worker during rearrangement work can be significantly reduced as compared with conventional structures.

(2) The tile according to (1), in which the engagement part is formed on an end part side of the tile main part. Such a structure allows remote operation by the clamp mechanism. Thus, further reduction in the burden of work can be achieved.

(3) The tile according to (1) or (2), in which the tile main part has a trapezoidal shape where the side antecedently inserted into the rolling mill in the axial direction is a top base or a bottom base. Due to such a structure, a gap does not exist when the roll is inserted into a housing, and the position of the roll is fixed. In addition, the tile can be smoothly inserted when being inserted into the housing. This can further reduce the burden of the worker.

(4) A rolling mill including the tile according to any of (1) to (3).

[Explanation of Reference Numerals]

[0114]

1: Strip (Metal Strip)
2: Work Roll
2a: Upper Work Roll
2b: Lower Work Roll
3: First Intermediate Roll
3a, 3b: Upper First Intermediate Roll

3c, 3d: Lower First Intermediate Roll
4: Second Intermediate Roll
4a, 4c: Upper Second Intermediate Drive Roll
4b: Upper Second Intermediate Roll
4d: Lower Second Intermediate Drive Right Roll
4e: Lower Second Intermediate Roll
4f: Lower Second Intermediate Drive Left Roll
5: Backup Roll
6: Shaft
7, 7a: Tile
7a1: Tile Main Part
7a2: Engagement Part
8: Split Backing Bearing
9: Coolant Spray Header
23, 23a: Tile Clamp
25: Upper Mill Housing
26: Lower Mill Housing
100: Roll Rearrangement Device
110: Carriage
112: Wheel
120: X-Axis Direction Movable Section (Orthogonal Direction Position Adjustment Section)
122: Y-Axis Direction Movable Section (Axial Position Adjustment Section)
124: Z-Axis Direction Movable Section (Perpendicular Position Adjustment Section)
130: Support Beam
140: Roll Holding Section
150: Holding Section For Upper Second Intermediate Roll
154: Holding Section For Upper Second Intermediate Drive Roll
158: Holding Section For Lower Second Intermediate Roll
159, 163: Inner Circumference Part
160, 164: Rotating Part
161, 165: Stopper
162: Holding Section For Lower Second Intermediate Drive Right Roll
166: Holding Section For Lower Second Intermediate Drive Left Roll
167: Wall Part
168: Flat Plate Part
170: Holding Section For Lower Backup Roll
174: Holding Section For Upper Backup Roll
180: Header Holding Mechanism (Header Holding Section)
184: Upper Fixing Section
188: Lower Fixing Section
200: Multi-high Rolling Mill
A: First Upper Backup Roll (A-Axis)
B: Second Upper Backup Roll (B-Axis)
C: Third Upper Backup Roll (C-Axis)
D: Fourth Upper Backup Roll (D-Axis)
E: First Lower Backup Roll (E-Axis)
F: Second Lower Backup Roll (F-Axis)
G: Third Lower Backup Roll (G-Axis)
H: Fourth Lower Backup Roll (H-Axis)

Claims

1. A roll rearrangement device (100) comprising:

a carriage (110) capable of travelling in an axial direction of a roll (4, 4A, 4B, 4C, 4D, 4E, 4F, 5, A, B, C, D, E, F, G, H) provided in a rolling mill (200);
a support beam (130) that is provided so as to be movable with travelling of the carriage (110) and taken in and out of the rolling mill (200); and
two roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) that are provided with an interval in the axial direction of the support beam (130) and are capable of attaching and detaching the roll.

2. The roll rearrangement device (100) according to claim 1, further comprising:
an axial direction position adjustment section (122) that adjusts an axial direction position of each of the roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) in the axial direction.

3. The roll rearrangement device (100) according to claim 1 or 2, wherein
the roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) further have an attachable and detachable hook (159, 160, 161, 163, 164, 165, 167, 168) that holds a neck of the roll from a lower side.

4. The roll rearrangement device (100) according to claim 3, further comprising:

a perpendicular direction position adjustment section that adjusts a position of each of the roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) in a perpendicular direction; and
an orthogonal direction position adjustment section that adjusts a position of each of the roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) in an orthogonal direction relative to the axial direction and the perpendicular direction, wherein
the hook (159, 160, 161, 163, 164, 165, 167, 168) has

an inner circumferential part (159, 163) that gets contact with part of outer circumference of the neck,
a rotation part (160, 164) that rotates the inner circumferential part in a circumferential direction, and
a stopper (161, 165) that stops rotation of the rotation part in the circumferential direction when the inner circumferential part (159, 163) has been fitted to the neck.

5. The roll rearrangement device (100) according to

claim 3, further comprising:

a perpendicular direction position adjustment section (124) that adjusts a position of each of the roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) in a perpendicular direction; and
an orthogonal direction position adjustment section (120) that adjusts a position of each of the roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) in an orthogonal direction relative to the axial direction and the perpendicular direction, wherein
the hook (159, 160, 161, 163, 164, 165, 167, 168) has an anti-tumbling mechanism (167, 168) for the roll.

6. The roll rearrangement device (100) according to claim 1 or 2, wherein
the roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) are configured to be attachable and detachable to and from the support beam (130).

7. The roll rearrangement device (100) according to claim 1 or 2, further comprising:

a header holding section (180) that is configured to be attachable and detachable to and from the support beam (130) and is capable of attaching and detaching a pair of upper and lower coolant spray headers (9) for spraying a coolant onto a front surface and a back surface of a metal strip (1) rolled by the rolling mill (200), wherein
the header holding section (180) has an upper fixing section (184) that fixes, at an upper part, the upper coolant spray header (9) to be attached or detached and a lower fixing section (188) that fixes, at a lower part, the lower coolant spray header (9) to be attached or detached.

8. A roll rearrangement method comprising:

equipping a carriage (110) capable of travelling in axial directions of rolls (4, 4A, 4B, 4C, 4D, 4E, 4F, 5, A, B, C, D, E, F, G, H) provided in a rolling mill (200) with a support beam (130) that is taken in and out of the rolling mill (200), and with two roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) that are provided with an interval in the axial direction of the support beam (130) and are capable of attaching and detaching the roll;
inserting the roll holding sections (140, 150, 154, 158, 162, 166, 170, 174) into inside of the rolling mill (200) by the support beam (130) and holding a replacement target roll to draw the replacement target roll from the rolling mill (200); and
inserting the support beam (130) into the inside of the rolling mill (200) in a state in which a roll for replacement is held by the roll holding sections (140, 150, 154, 158, 162, 166, 170, 174), and attaching the roll for replacement to the rolling mill (200).

9. The roll rearrangement method according to claim 8, wherein

when the rolling mill is a multi-high rolling mill (200) that is a 20-high rolling mill,
the rolls are drawn in order of upper second intermediate rolls (4A, 4B, 4C), lower second intermediate rolls (4D, 4E, 4F), lower backup roll F-shaft and G-shaft (F, G), lower backup roll E-shaft and H-shaft (E, H), upper backup roll B-shaft and C-shaft (B, C), and upper backup roll A-shaft and D-shaft (A, D).

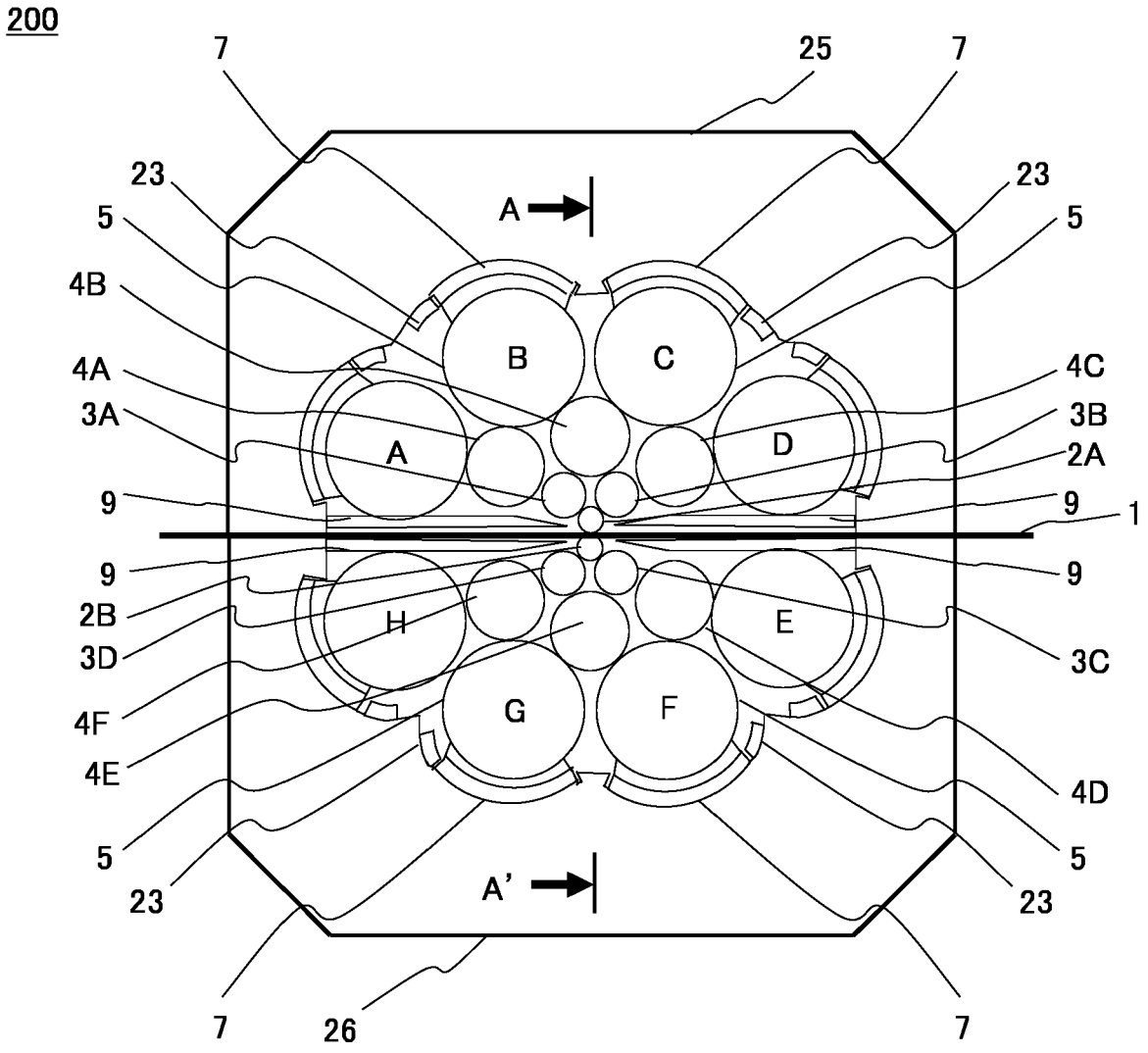
10. The roll rearrangement method according to claim 8 or 9, wherein
a coolant spray header (9) is drawn before the replacement target roll (4, 5) is drawn.

11. The roll rearrangement method according to claim 8 or 9, wherein,

when the rolling mill is a multi-high rolling mill (200) that is a 20-high rolling mill,
the rolls are attached in order of upper backup roll A-shaft and D-shaft (A, D), upper backup roll B-shaft and C-shaft (B, C), lower backup roll E-shaft and H-shaft (E, H), lower backup roll F-shaft and G-shaft (F, G), lower second intermediate rolls (4D, 4E, 4F), and upper second intermediate rolls (4A, 4B, 4C).

12. The roll rearrangement method according to claim 11, wherein
a coolant spray header (9) is attached after all of the rolls (4, 5) for replacement are attached.

Fig 1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7
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23
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5
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C
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9
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2B
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Fig 2

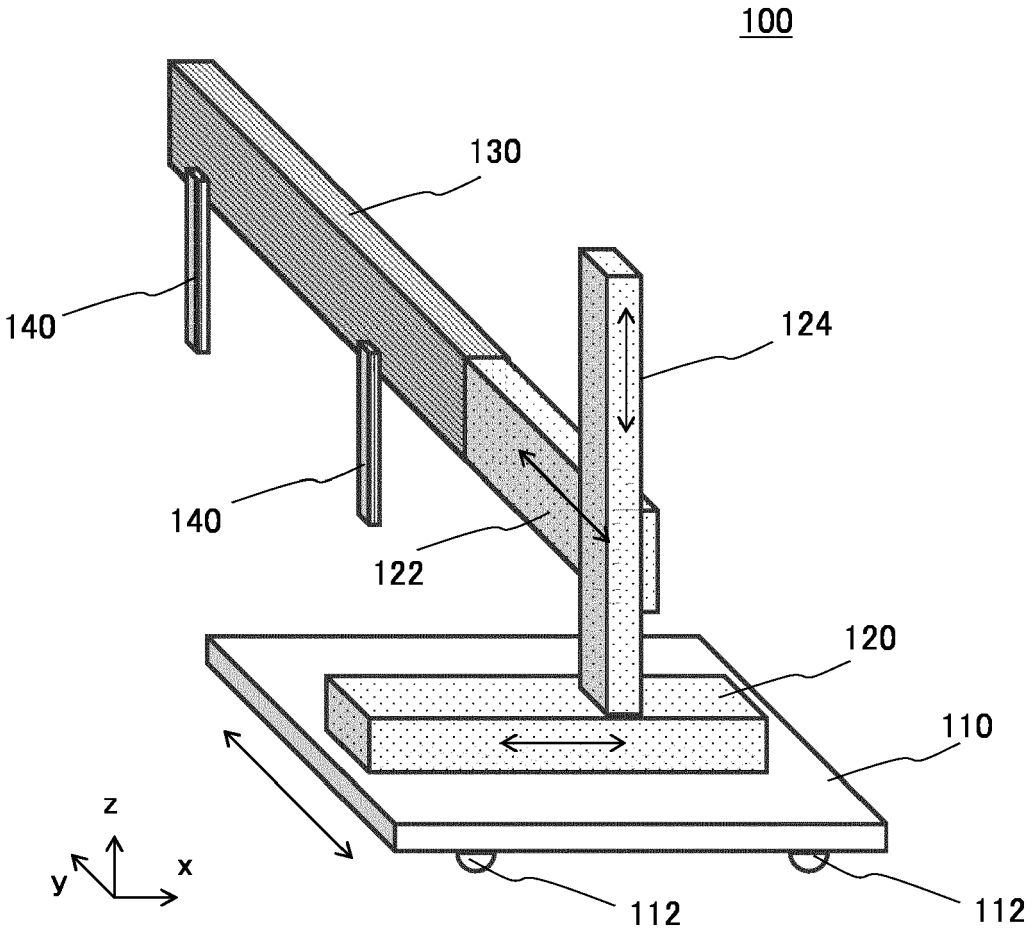

Fig 3

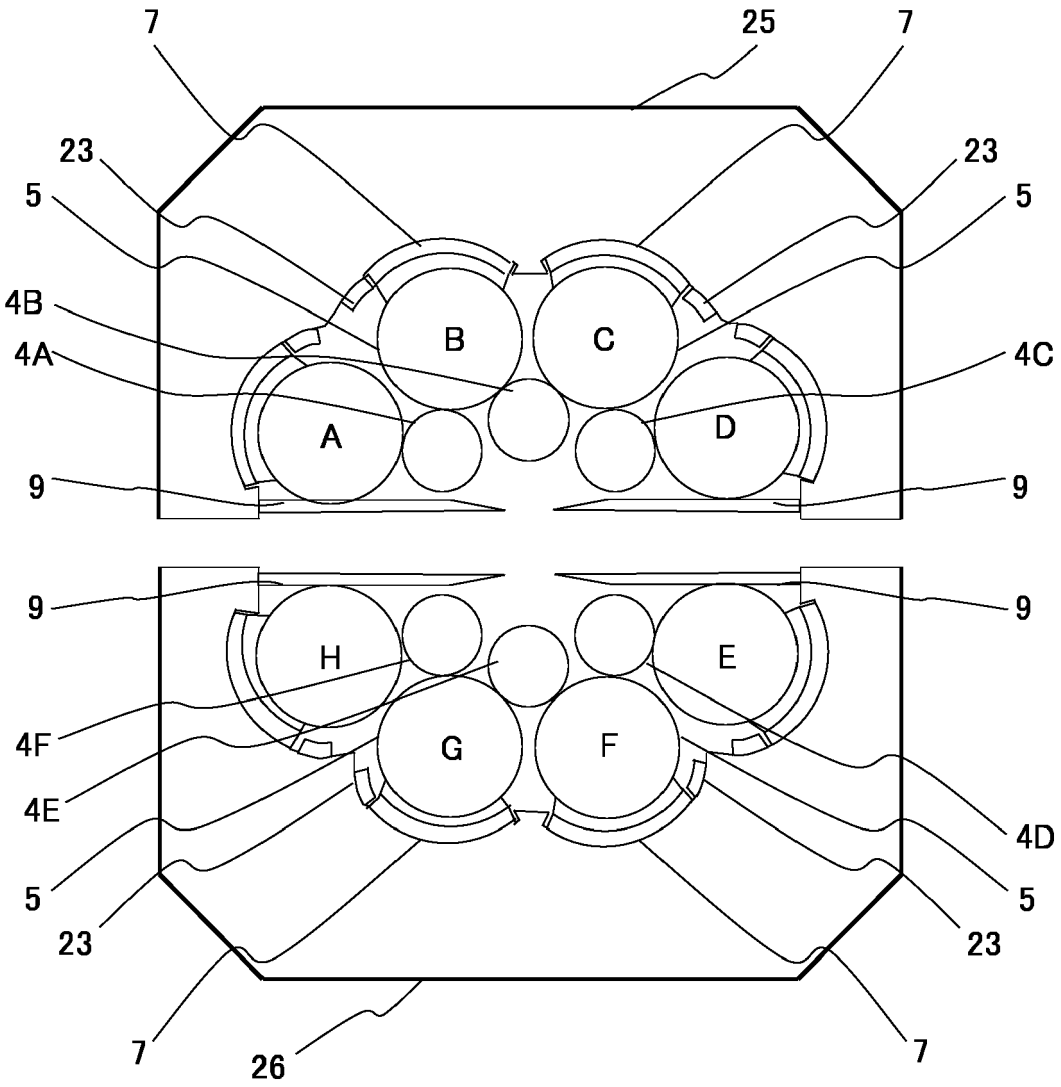

Fig 4

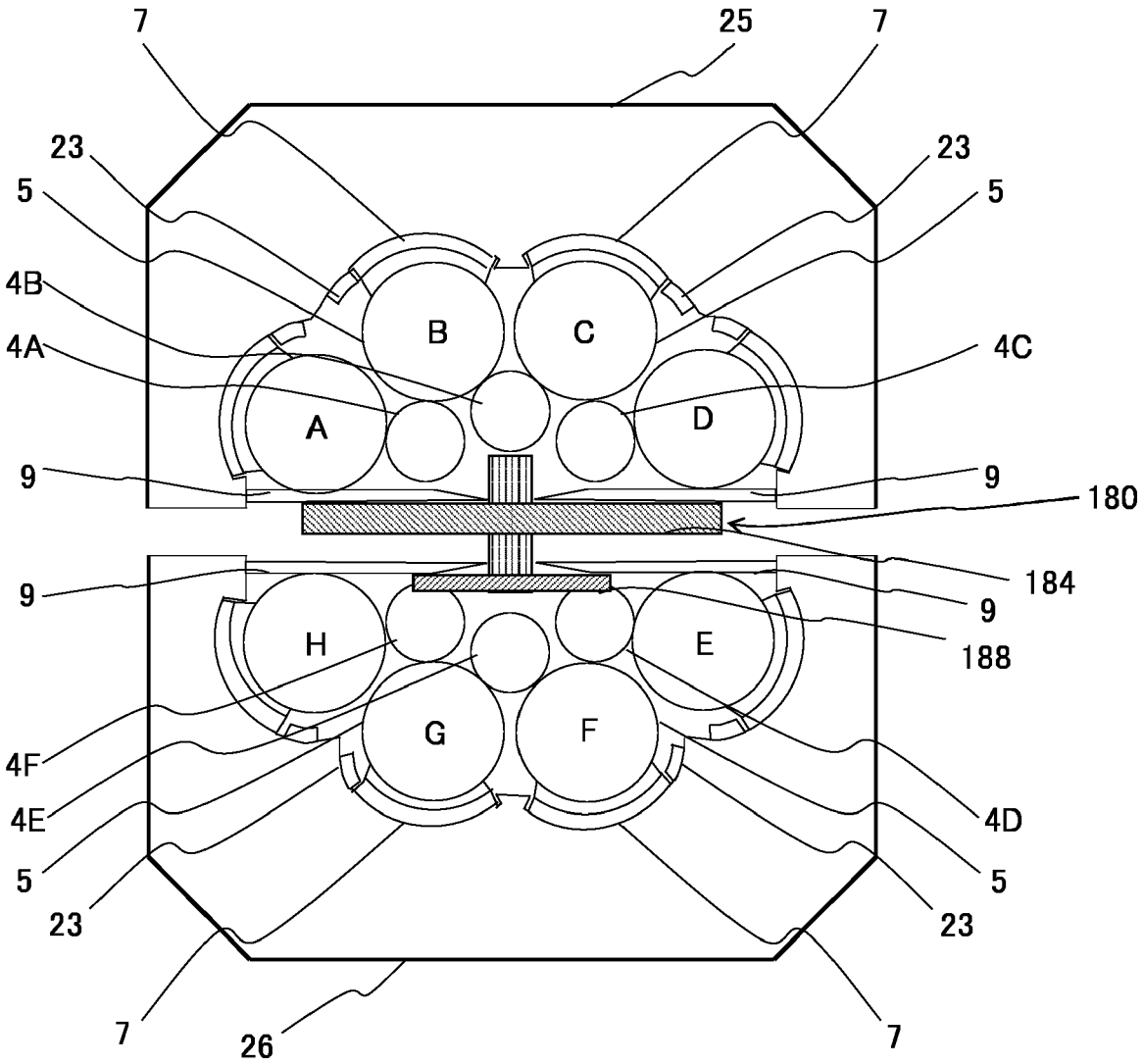
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Fig 5

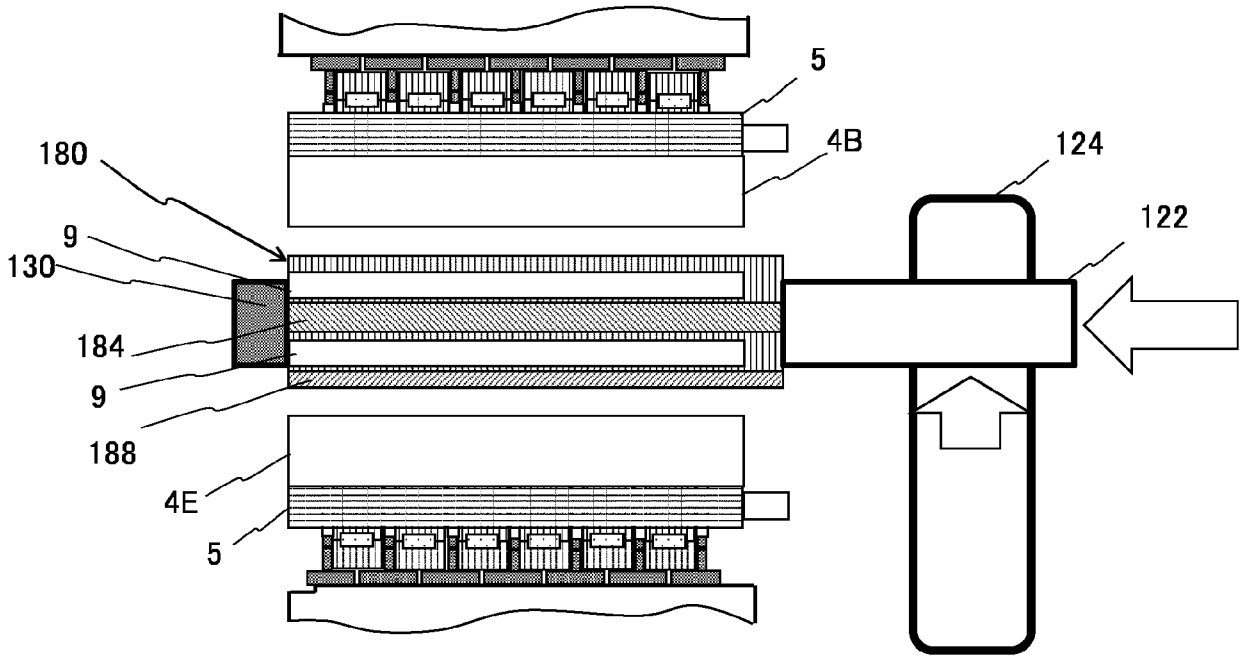
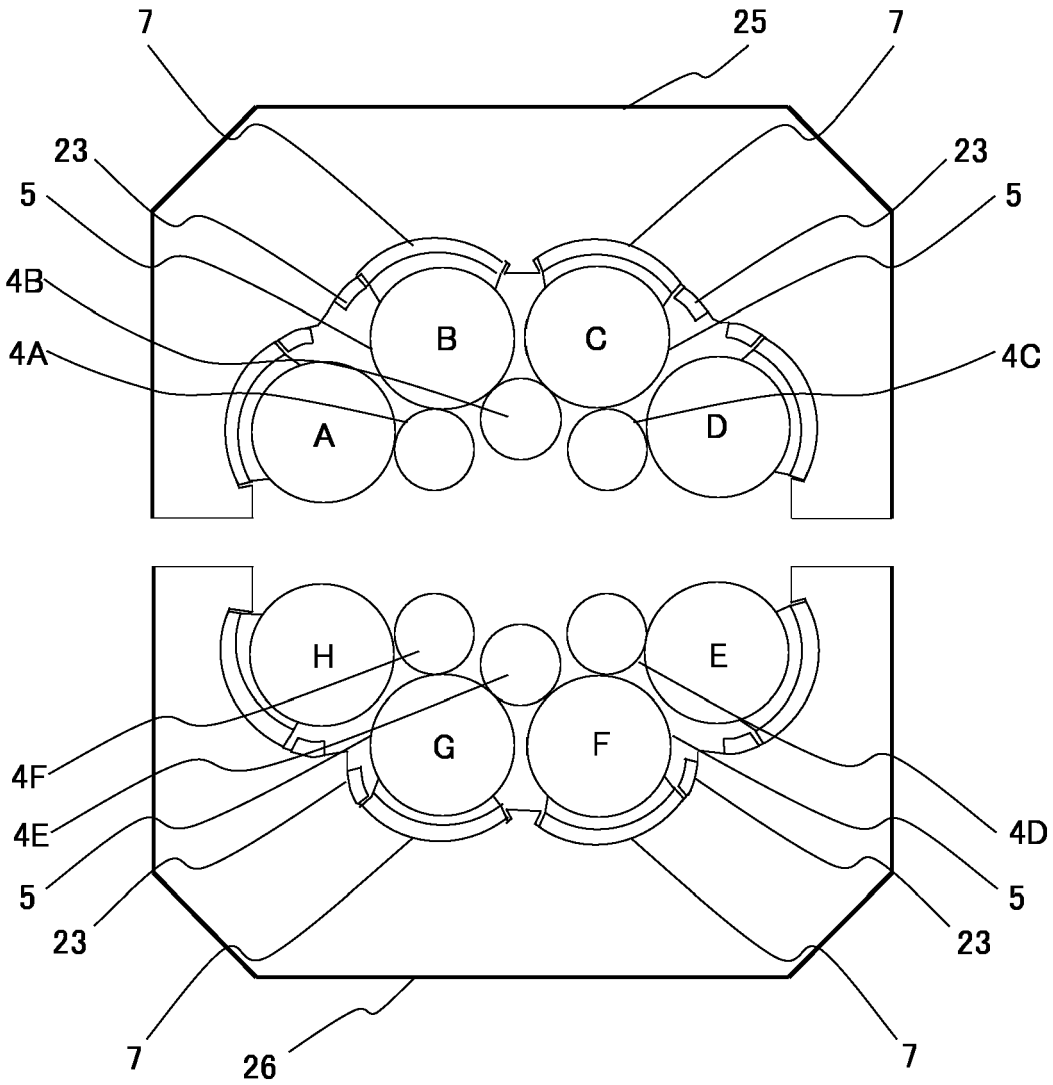


Fig 6



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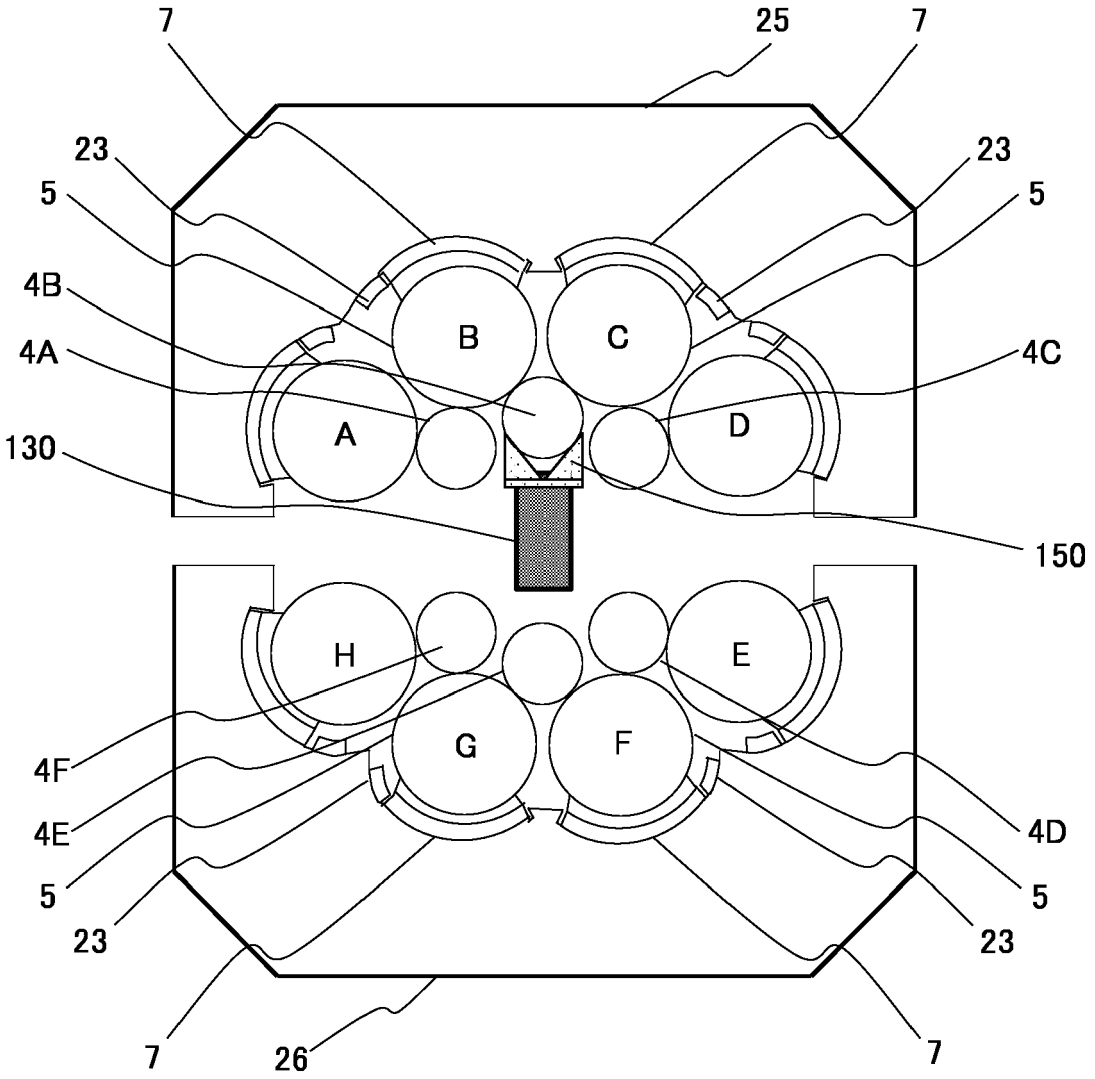

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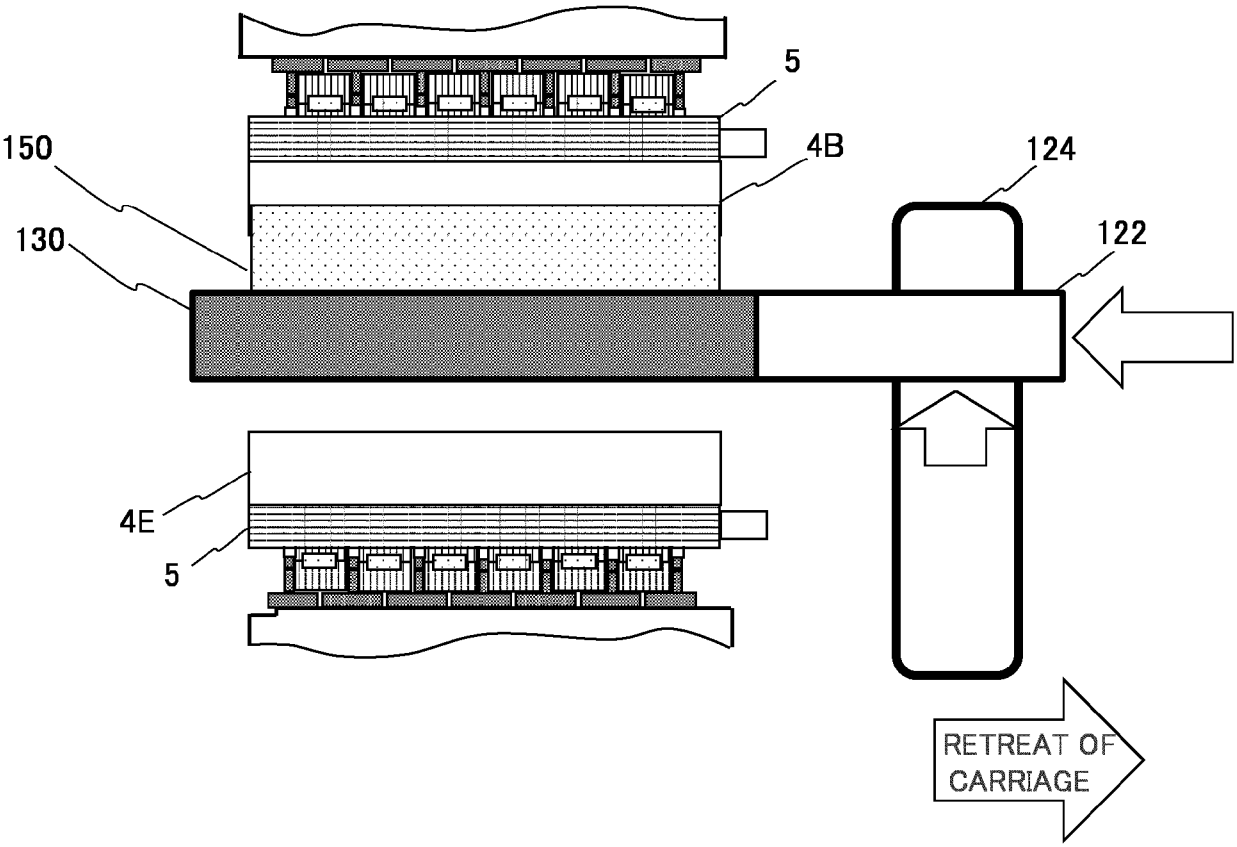

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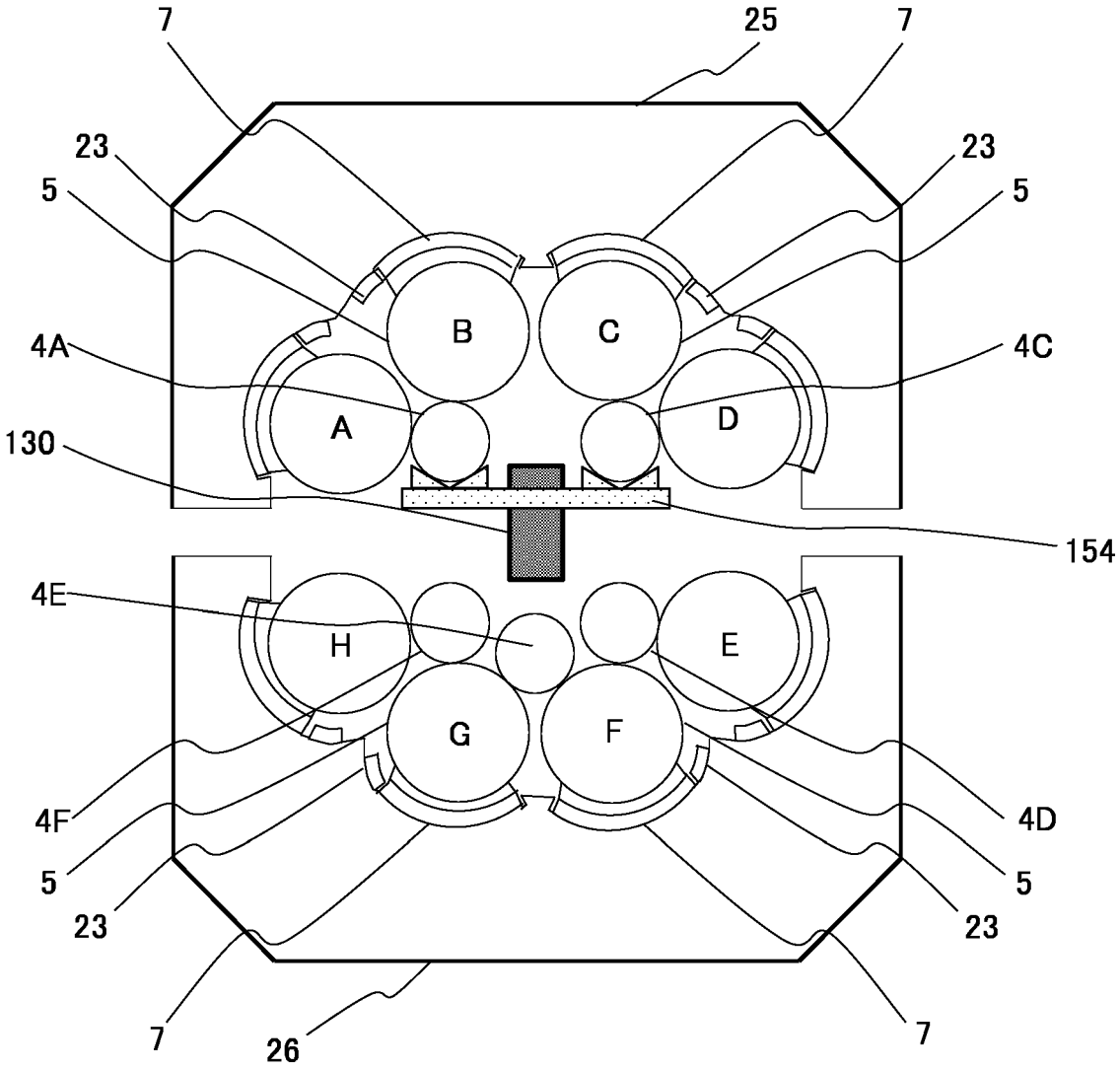


Fig 10

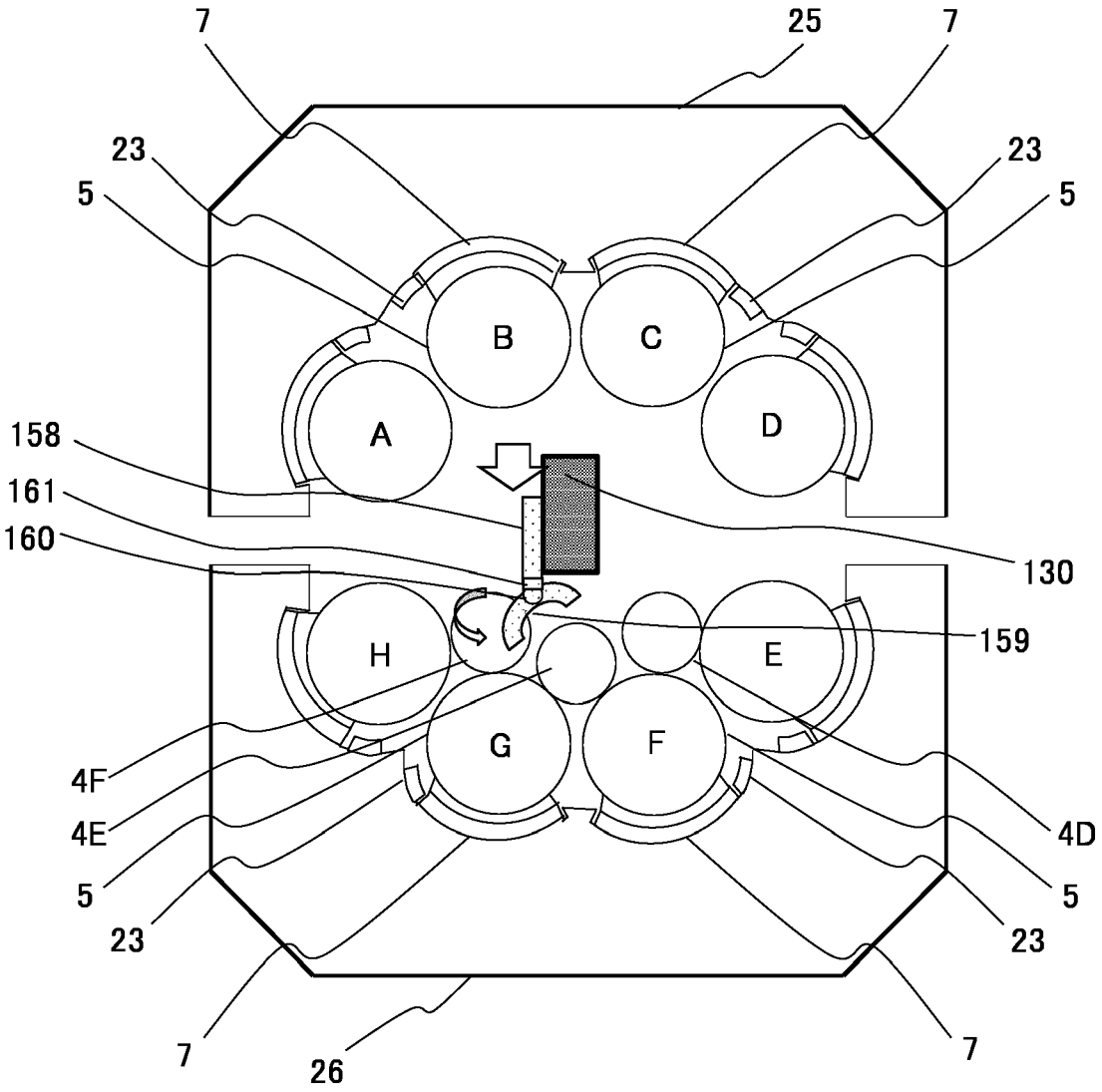
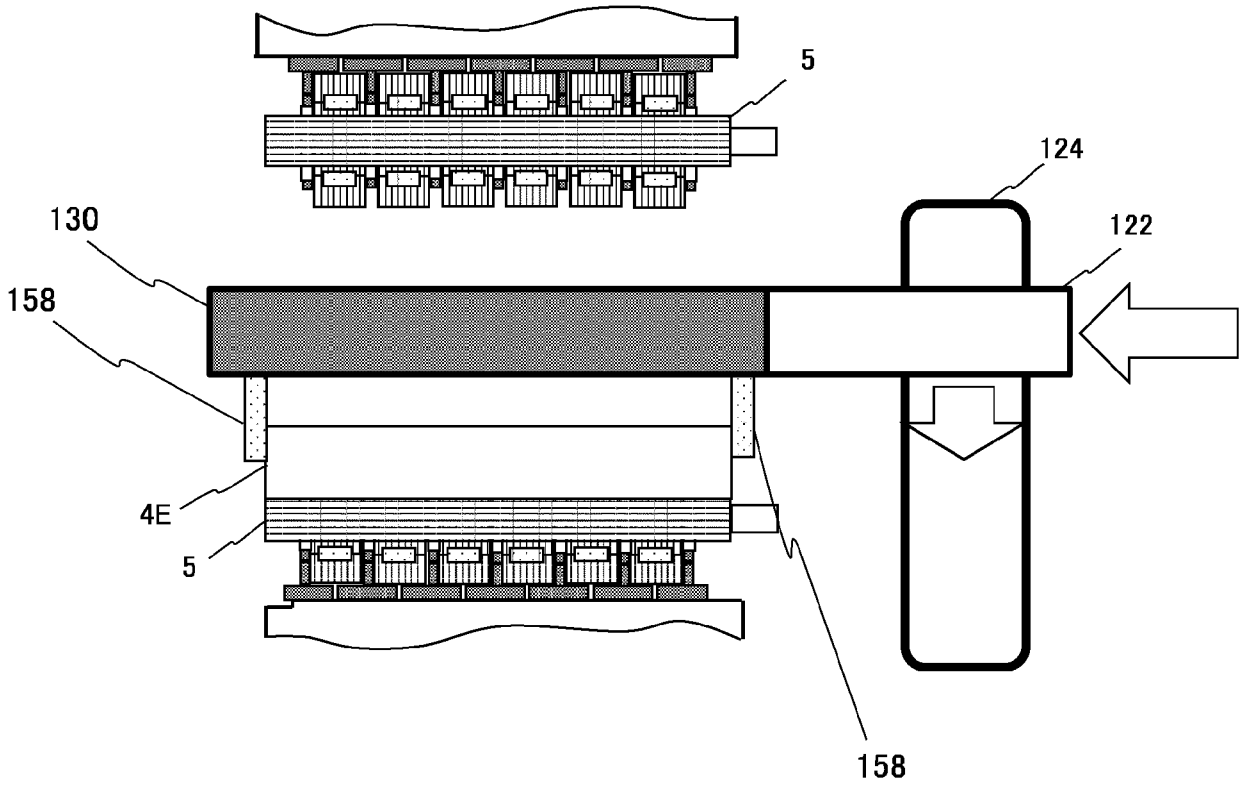


Fig 11



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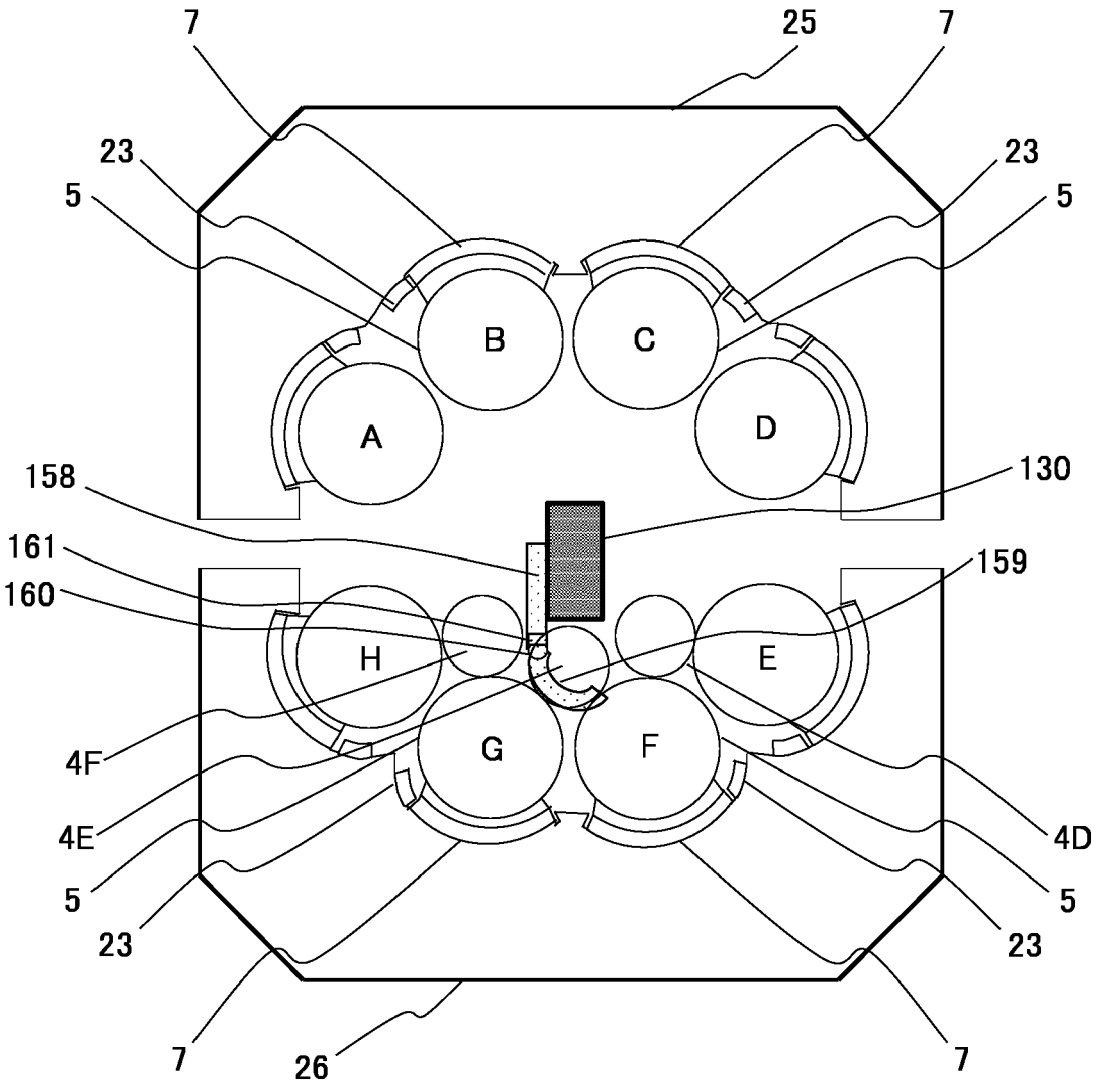
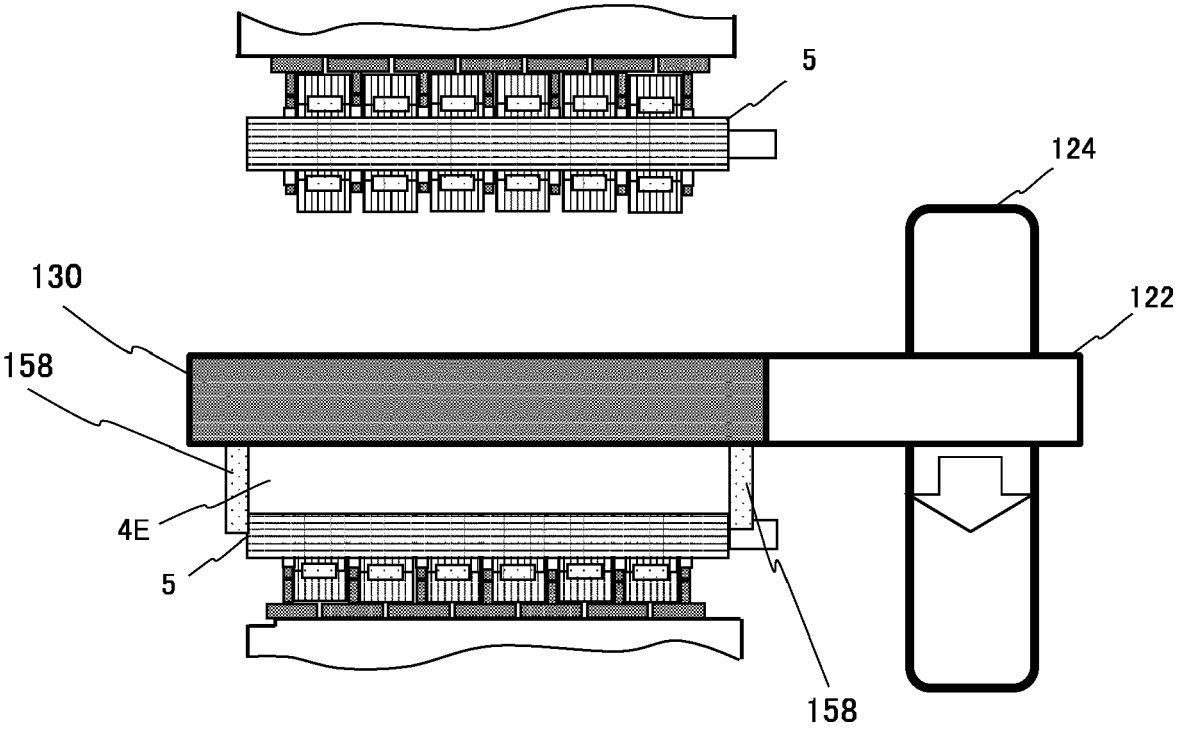


Fig 13



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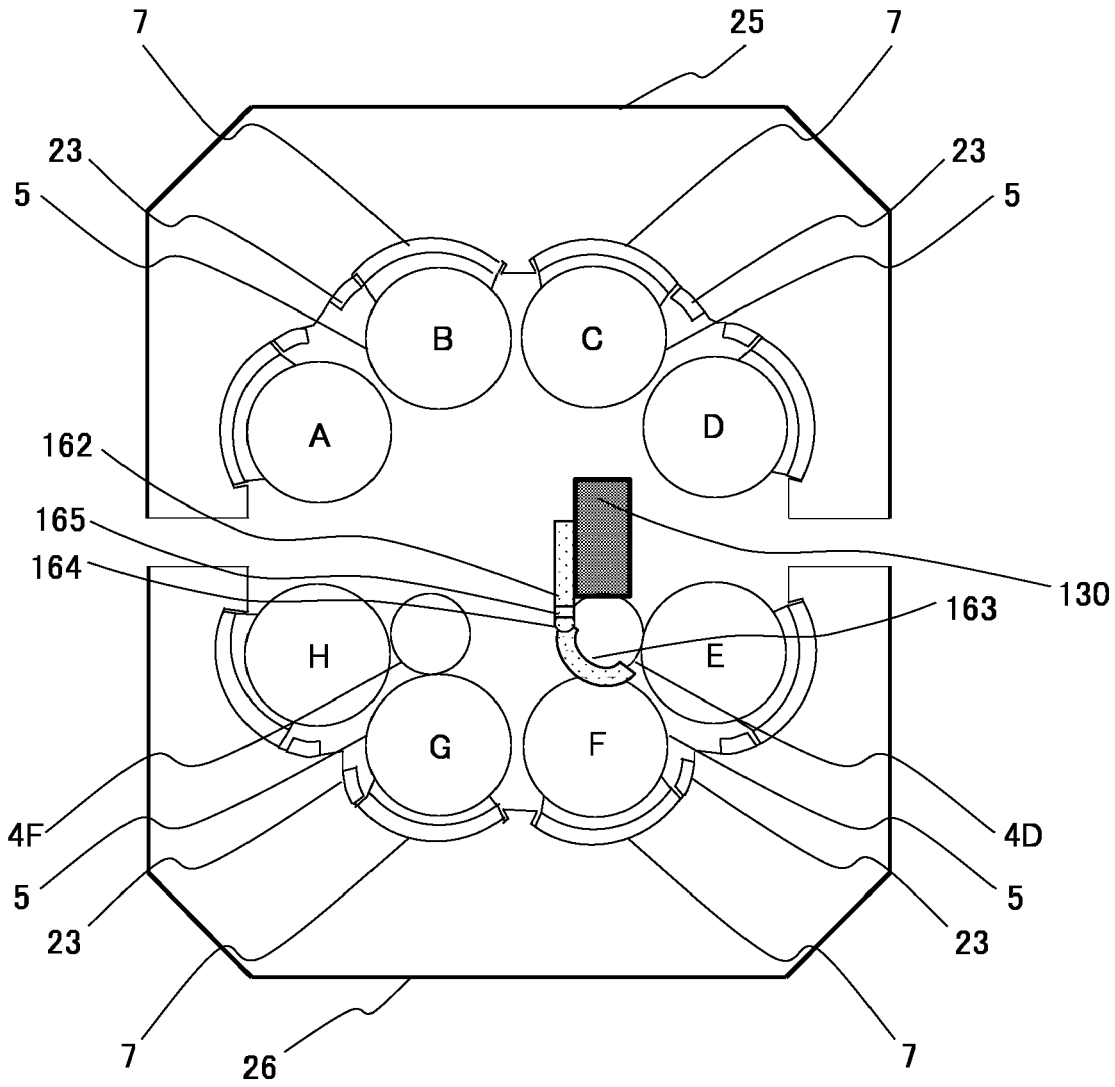


Fig 15

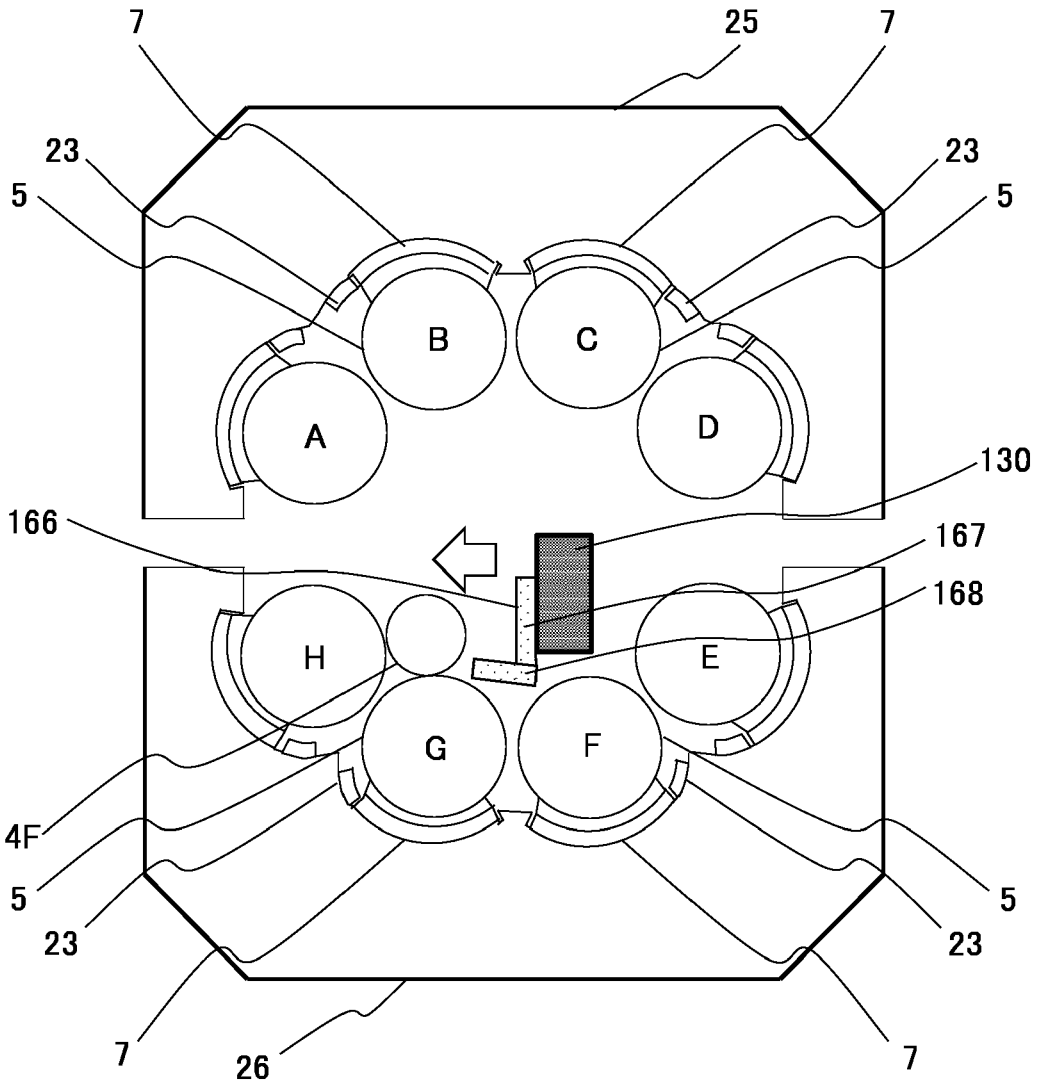


Fig 16

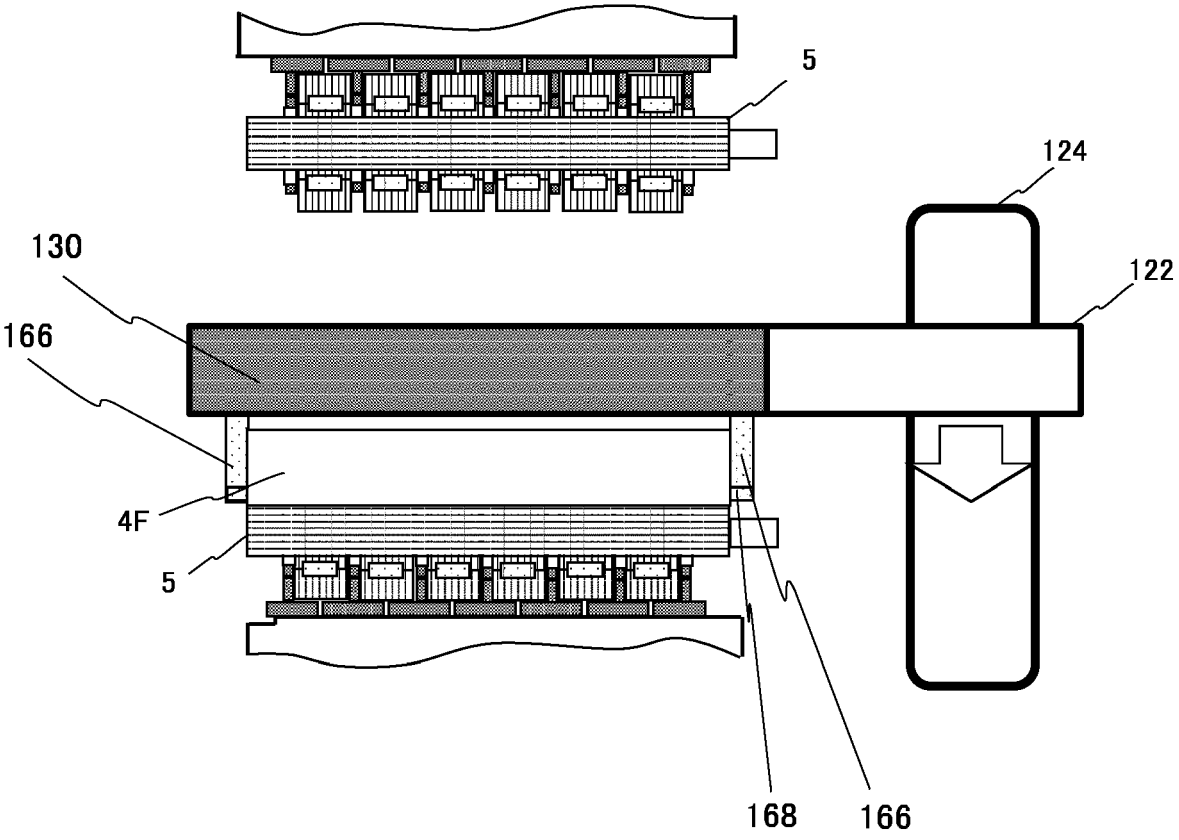
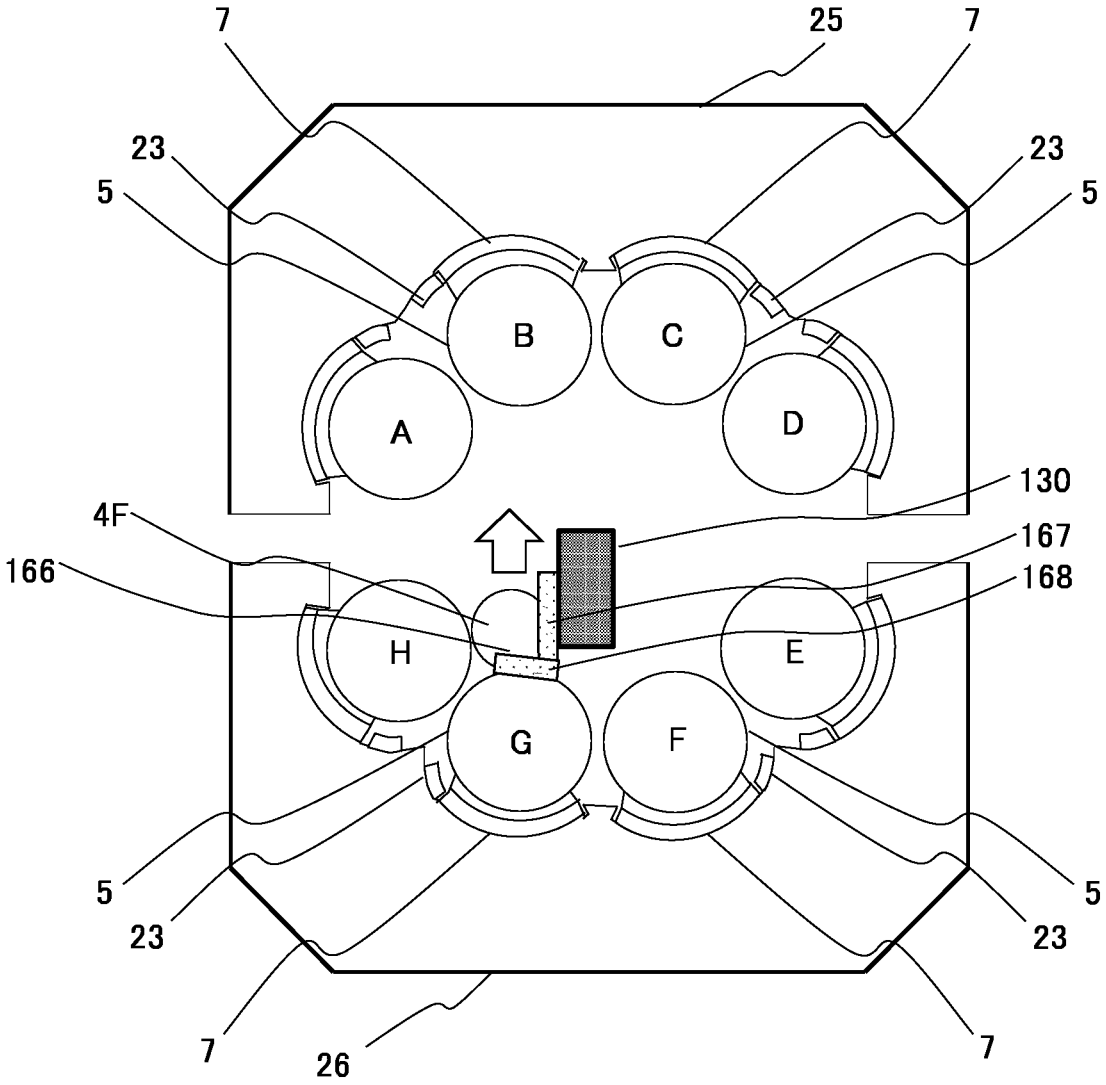


Fig 17



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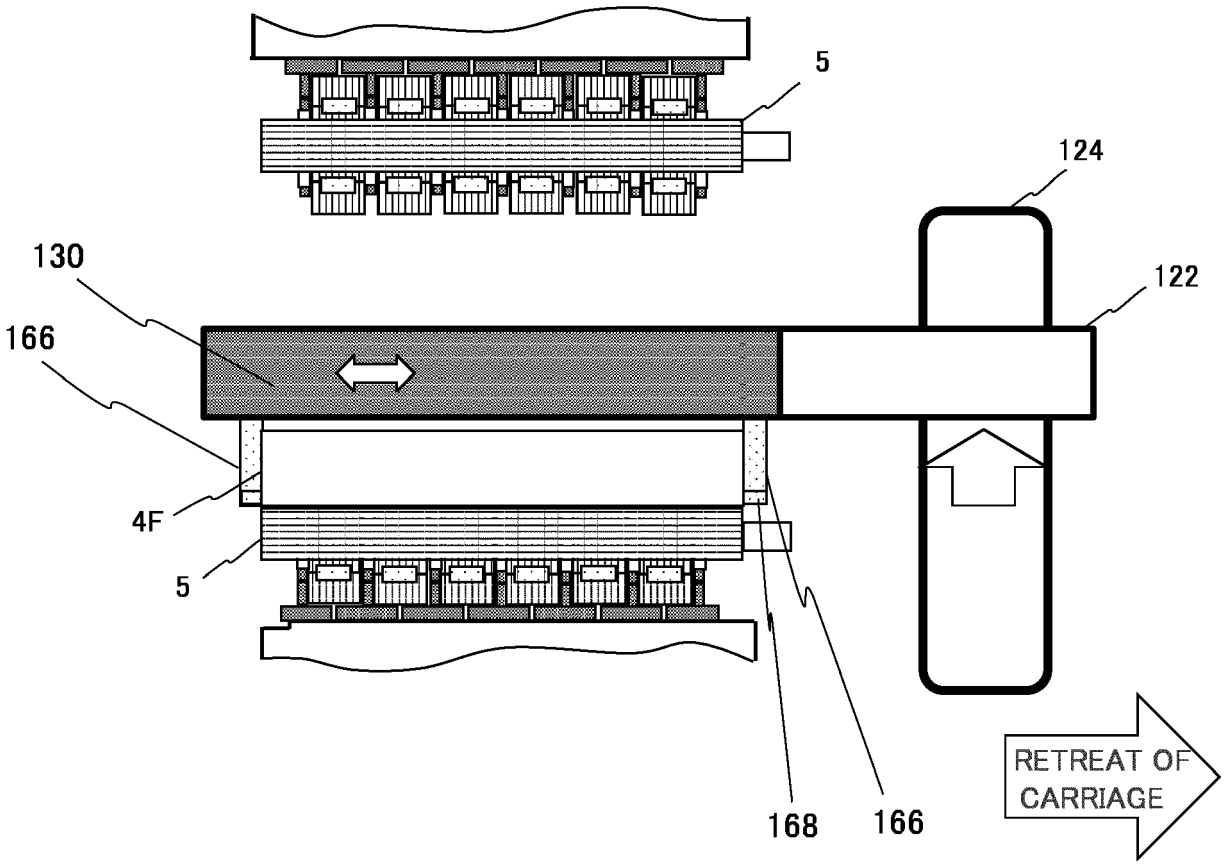


Fig 19

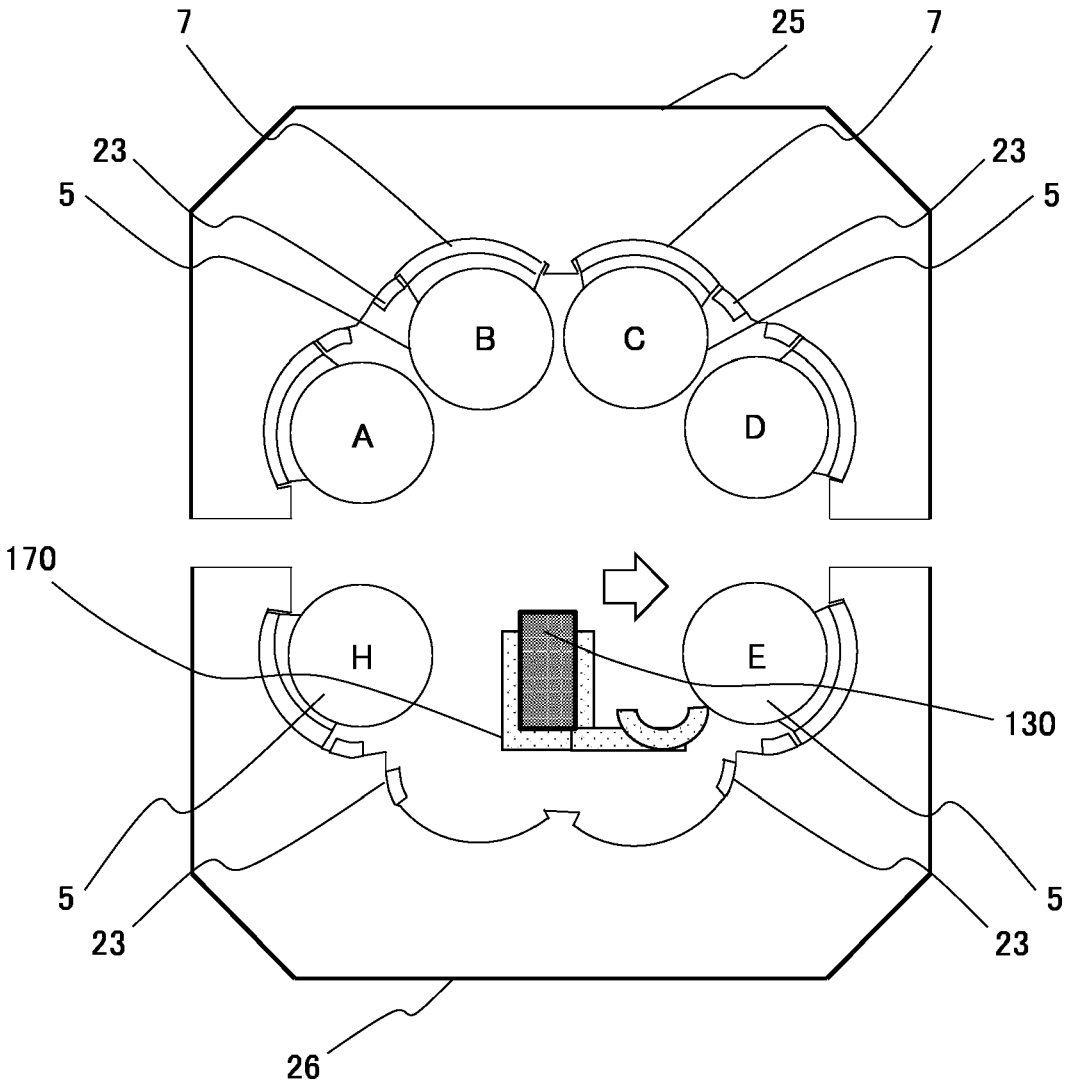


Fig 20

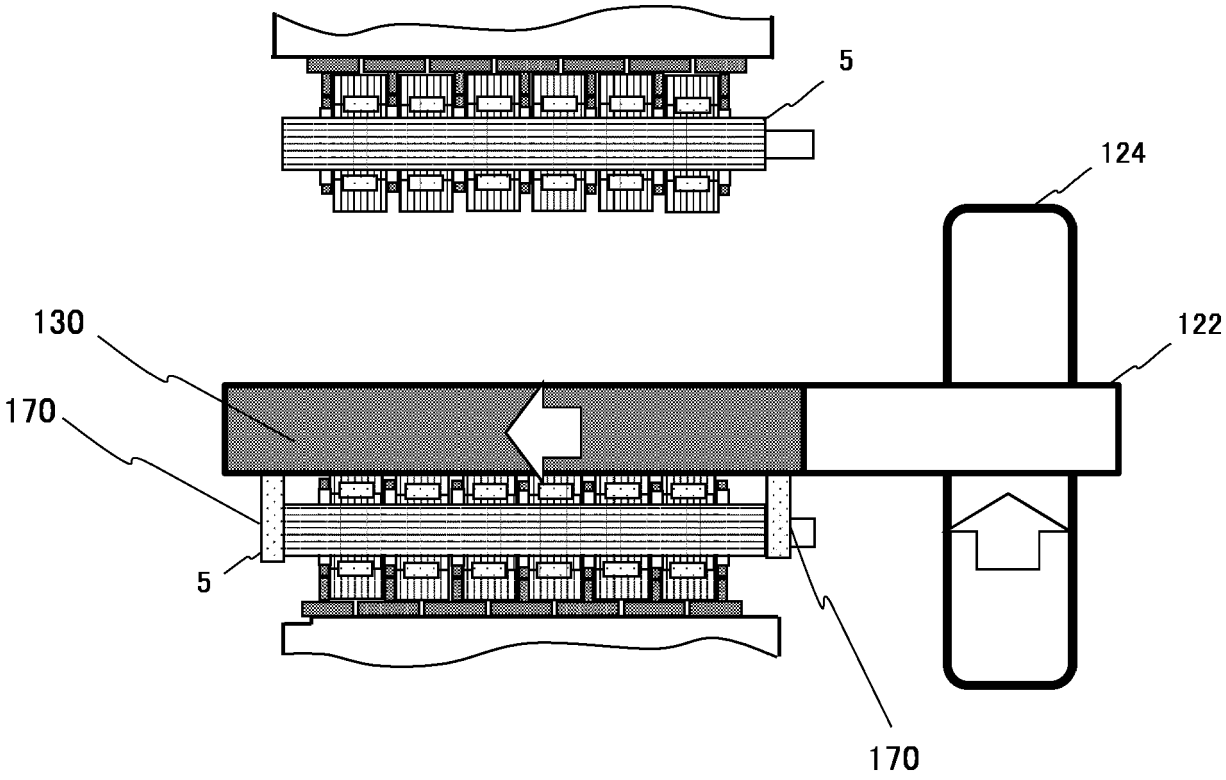


Fig 21

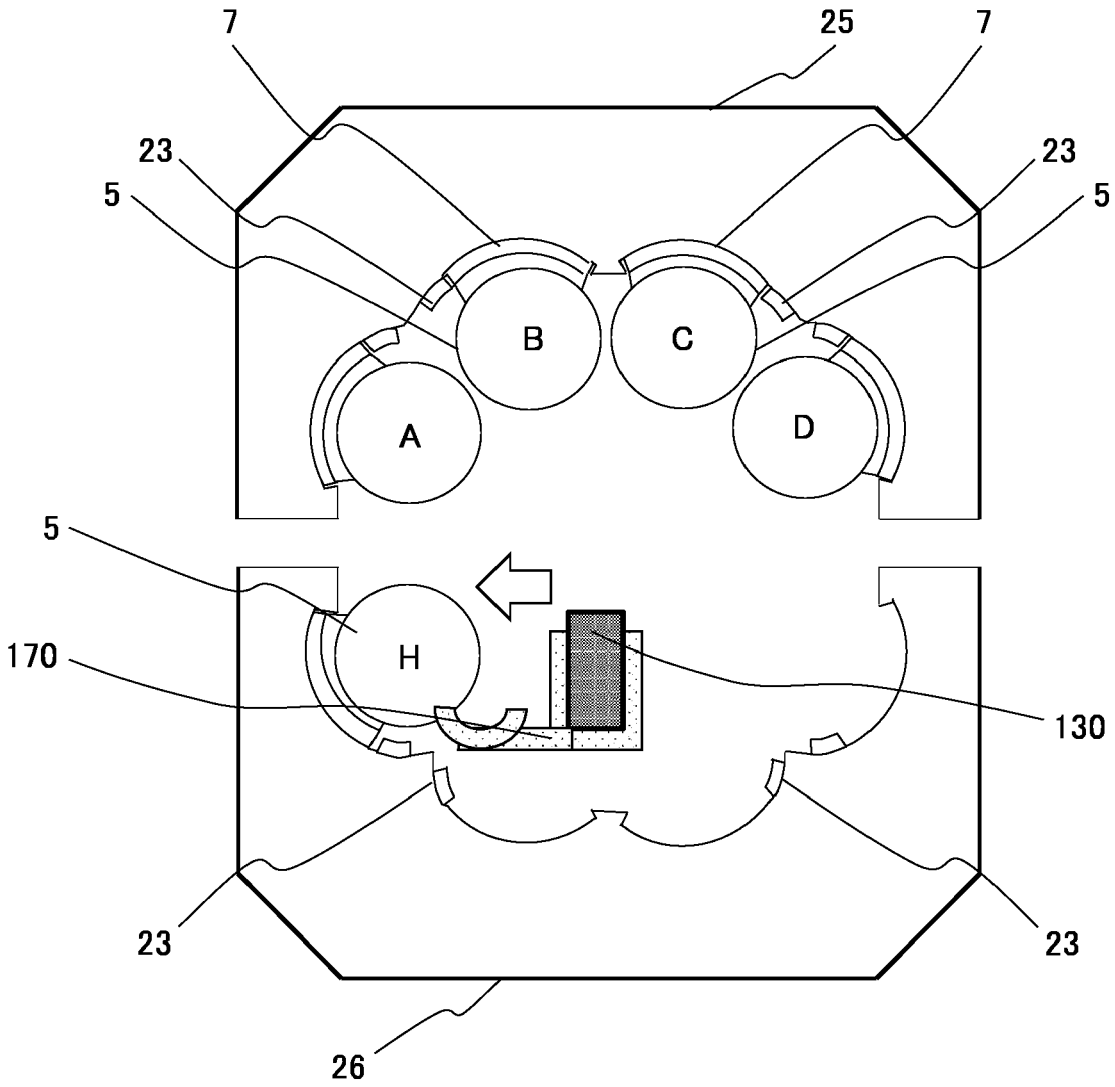


Fig 22

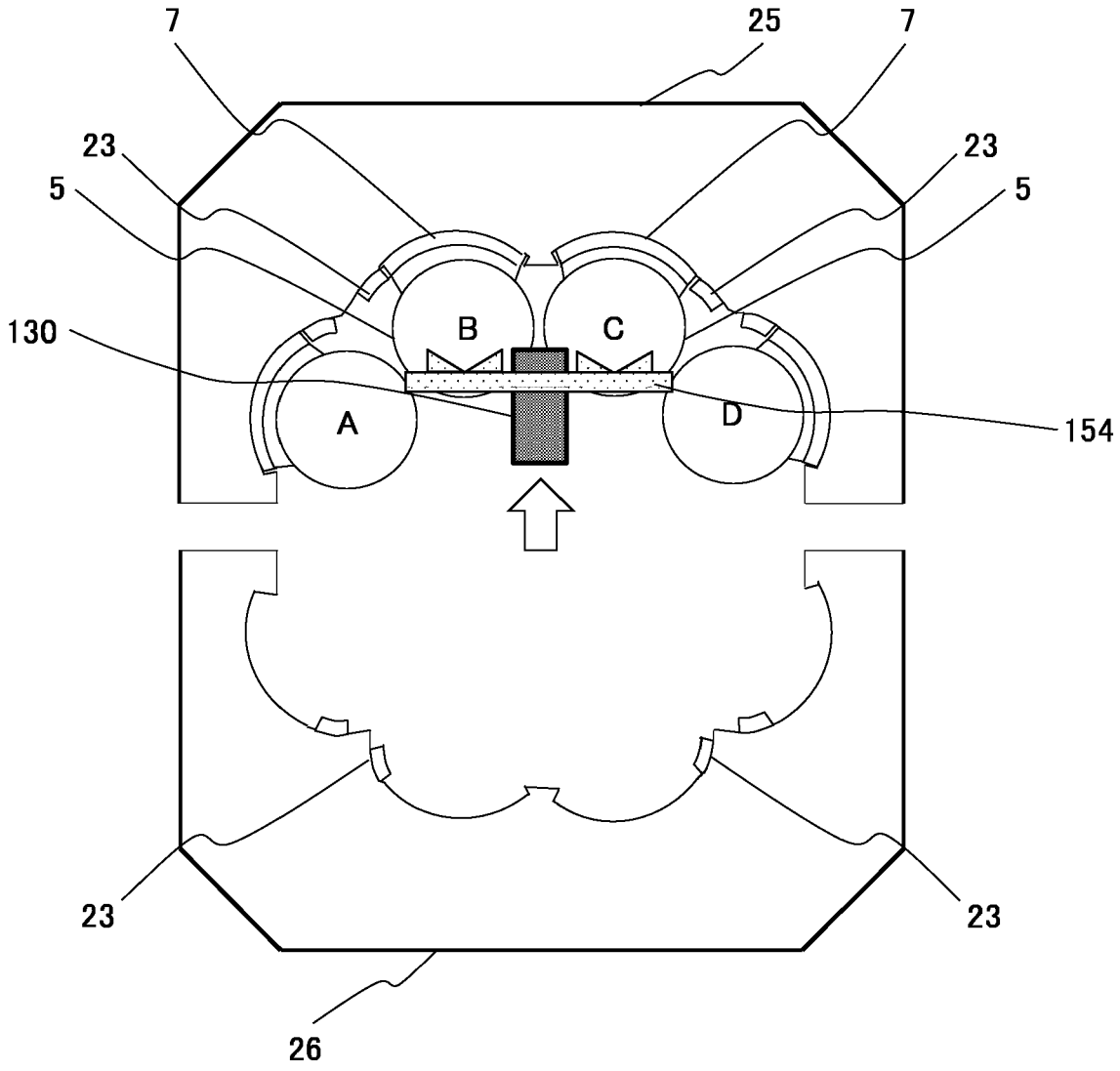


Fig 23

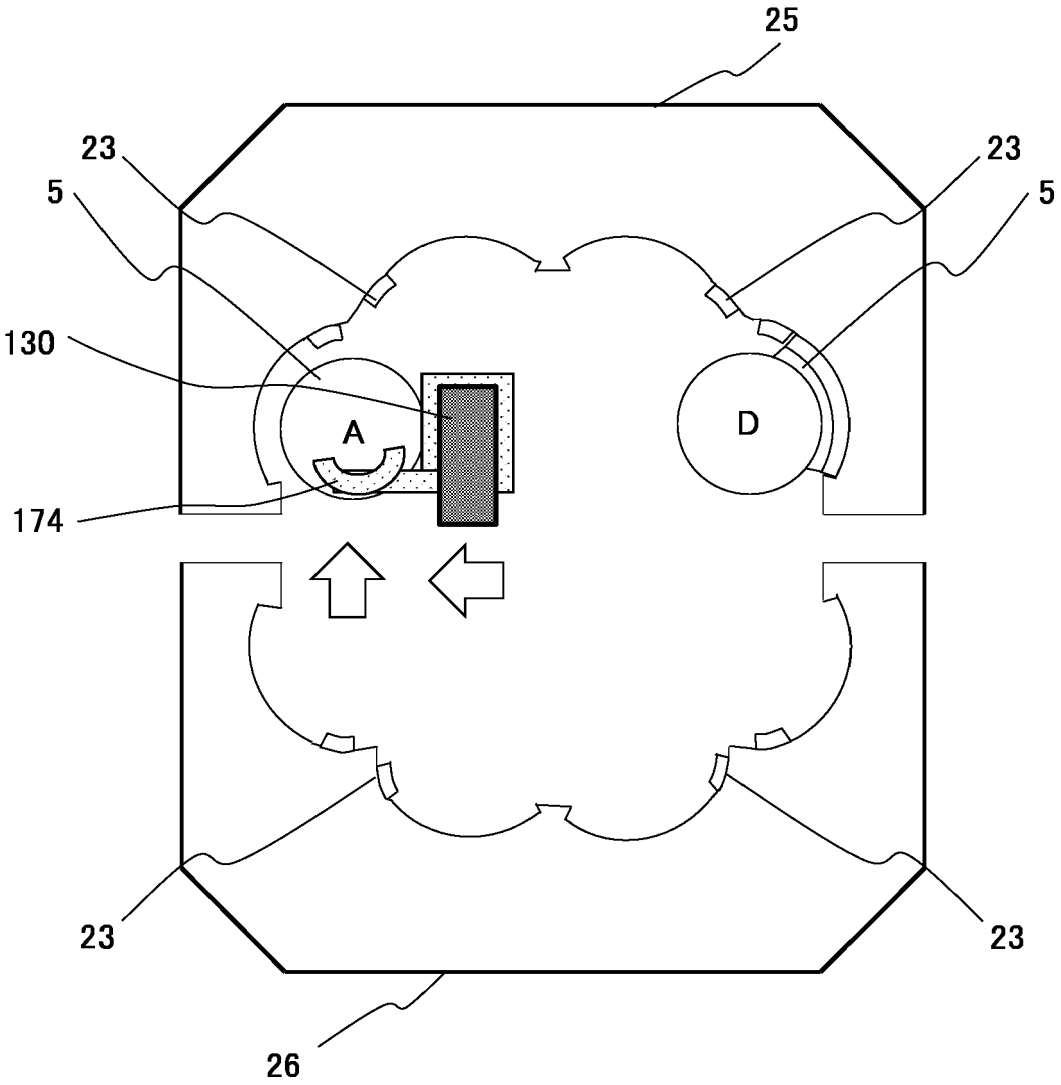


Fig 24

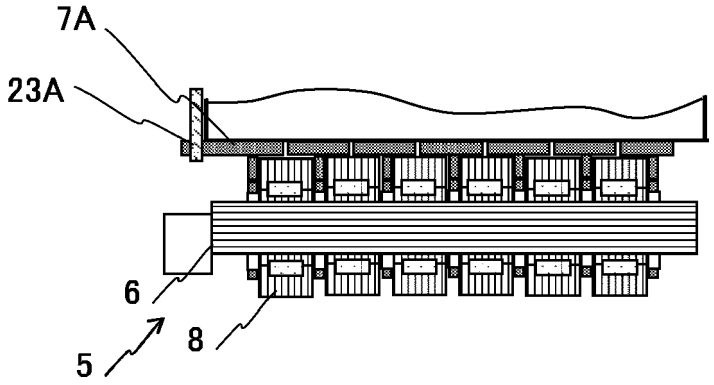


Fig 25

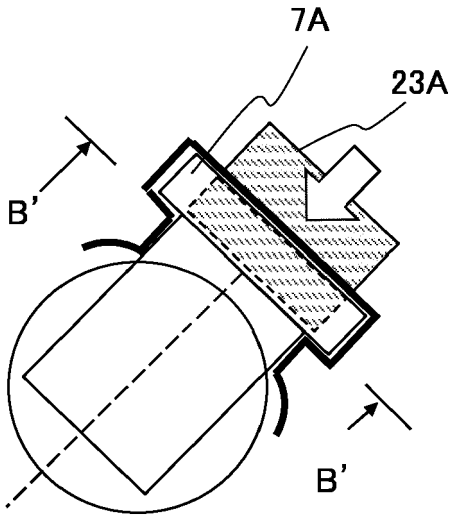
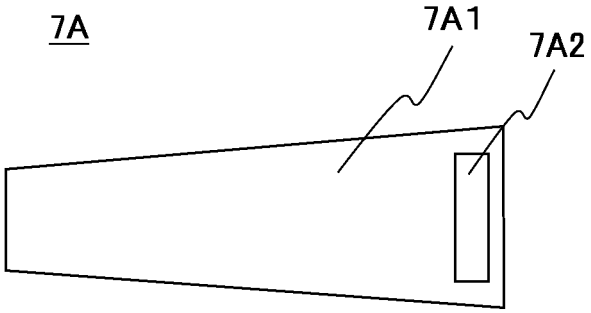


Fig 26



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Application Number
EP 24 19 4633

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP H02 112807 A (HITACHI LTD) 25 April 1990 (1990-04-25)	1-3,6-9	INV. B21B13/14 B21B31/10
Y	* abstract; figures 3,4 *	4,5, 10-12	

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Y	* abstract; figures 1,2 *	4,5, 10-12	

TECHNICAL FIELDS SEARCHED (IPC)

B21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 January 2025	Frisch, Ulrich

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