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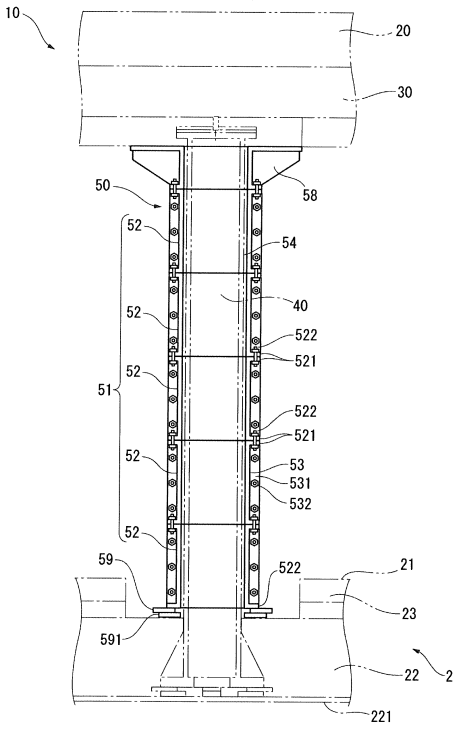
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(54) SUPPLEMENTARY POST FOR CHECKER BRICK BRACKET, CHECKER BRICK BRACKET AND POST-INCREASING METHOD

(57) A checker brick-receiving metal (10) includes: a metal grille (20) receiving checker bricks in a hot-blast stove (2); an existing post (40) provided between the metal grille (20) and a hearth surface (21) of the hot-blast stove (2); and a coaxial supplementary post (50) coaxially provided outside the existing post (40). The coaxial supplementary post (50) includes: a post body (51) coaxially provided outside the existing post (40); and a height adjustment mechanism (59) configured to adjust a height of the post body (51). The post body (51) includes a plurality of post cylinders (52) stacked on each other in a height direction.

FIG. 6



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Description

TECHNICAL FIELD

[0001] The invention relates to a supplemental post for a checker brick-receiving metal supporting checker bricks in a checker chamber of a hot-blast stove, the checker brick-receiving metal, and a method of additionally installing a post.

BACKGROUND ART

[0002] A hot-blast stove has been typically used as equipment for supplying hot blast to a blast furnace for producing pig iron.

[0003] A plurality of (three to five) hot-blast stoves are installed to a single blast furnace. At least one of the hot-blast stoves stores heat and the rest of the hot-blast stoves supply hot blast to the blast furnace, whereby the hot blast can be continuously supplied to the blast furnace.

[0004] The hot-blast stoves each include a combustion chamber and a checker chamber. Checker bricks for storing heat are stacked in the checker chamber. A checker brick-receiving metal for supporting the checker bricks is provided on a hearth of each of the hot-blast stoves. A duct is connected to a lower lateral surface of each of the hot-blast stoves so that the duct is in communication with a space formed under the checker brick-receiving metal.

[0005] An exemplary known checker brick-receiving metal has a structure in which a support stand is erected on a hearth of a hot-blast stove and supports a horizontal girder and a metal grille extends over an upper surface of the horizontal girder (see Patent Literature 1). The checker bricks are received on an upper surface of the metal grille. The metal grille has holes corresponding to through-holes of the checker bricks. A ventilation space is created between a lower surface of the metal grille and the hearth of the hot-blast stove. The ventilation space is in communication with the aforementioned duct. This arrangement allows the checker bricks, the metal grille, the ventilation space and the duct to be ventilated.

[0006] When storing heat in the hot-blast stove, the hot blast having heated the checker bricks is injected downwards from the through-holes in the lowest course of the checker bricks to be gathered in the ventilation space, and subsequently is exhausted to the outside from the duct.

[0007] When supplying the hot blast to the blast furnace, air from outside is introduced into the ventilation space via the duct. From the ventilation space, the air is distributed to the through-holes in the checker bricks. The air is heated during passing through the checker bricks and delivered to the blast furnace as the hot blast.

[0008] The blast furnace to be supplied with the hot blast from the hot-blast stove requires cokes as a reduction-causing material of iron ore and a heat source for melting the iron ore. Since increasing a temperature of the hot blast from the hot-blast stove to a high temperature enables to reduce a consumption amount of cokes and a consequent reduction in a running cost, the temperature of the hot blast supplied from the hot-blast stove to the blast furnace is desirably increased to a high temperature.

CITATION LIST

PATENT LITERATURE(S)

[0009] Patent Literature 1: JP 51-20004 A

SUMMARY OF THE INVENTION

PROBLEM(S) TO BE SOLVED BY THE INVENTION

[0010] As above described, in order to increase the temperature of the hot blast provided from the hot-blast stove to the blast furnace so that the hot blast provides a sufficient quantity of heat, the amount of heat (heat storage amount) stored in the checker bricks of the hot-blast stove needs to be increased, and the temperature of the checker bricks, particularly a temperature at the bottom of the checker bricks, needs to be increased.

[0011] However, when a temperature of the checker brick-receiving metal is equal to or higher than its heatproof temperature, the checker brick-receiving metal may be damaged and the checker bricks may collapse to stop the operation of the hot-blast stove. For this reason, the upper limit of an exhaust gas temperature of the hot-blast stove, which determines an atmosphere temperature of the hearth of the hot-blast stove, is determined depending on the heatproof temperature of the checker brick-receiving metal.

[0012] Accordingly, since the heated during heat storage, in which the hot blast is to be supplied to the blast furnace, is limited to a temperature equal to or more than the heatproof temperature of the checker brick-receiving metal, the upper limit of the stored heat energy of the checker bricks is limited. Consequently, the temperature of the hot blast supplied to the blast furnace cannot be further increased.

[0013] Here, it is conceivable that the upper limit of the stored heat energy of the checker bricks can be raised by replacing the existing checker brick-receiving metal of the hot-blast stove with a checker brick-receiving metal having a higher heatproof temperature.

[0014] However, the replacement of the checker brick-receiving metal requires large-scale replacement and reconstruction works including the replacement of the checker bricks. Such works require a long (e.g., for one year or longer) operation-halt period, so that a production amount in the blast furnace is decreased.

[0015] Alternatively, the temperature of the hot blast may be increased by additionally installing the post supporting the metal grille. The additional installation of the

post enables reinforcement of strength of the checker brick-receiving metal and improvement of the heatproof temperature.

[0016] However, it is difficult to dispose an additional support stand later if the existing support stands are insufficiently spaced. This is because a working space in addition to a disposal space for the additional support stand is required between the existing support stands. Since such an additional installation of the support stand depends on the layout of the existing support stands, the increased number of the support stands may be insufficient to fail to meet the demand for the increase in the temperature of the hot blast and the reduction in the running cost.

[0017] An object of the invention is to provide a supplemental post for a checker brick-receiving metal, the checker brick-receiving metal, and a method of additionally installing the supplemental post, which are capable of increasing a heat storage amount of checker bricks to increase a temperature, reduce a running cost, and shorten a construction period.

MEANS FOR SOLVING THE PROBLEM(S)

[0018] According to an aspect of the invention, a supplemental post for a checker brick-receiving metal, which is provided between a hearth surface and a metal grille receiving checker bricks in a hot-blast stove, includes: a post body provided outside an existing post provided between the metal grille and the hearth surface in a manner to be coaxial with the existing post; and a height adjustment mechanism configured to adjust a height of the post body, in which the post body includes a plurality of post cylinders stacked on each other in a height direction.

[0019] According to the above aspect of the invention, the post body disposed covering the periphery of the existing post forms the coaxial supplementary post that is coaxial with the existing post. The supplemental post being coaxial with the existing post means that a double post is formed by the outer supplemental post and the inner existing post disposed, in other words, that the supplemental post and the existing post share a disposal area in common. However, the center axis of the supplemental post and the center axis of the existing post are not necessarily in common (i.e., at the same position). Accordingly, as long as the supplemental post and the existing post do not interfere with each other, the supplemental post and the existing post may be disposed in a state that the supplemental post is eccentric relative to the existing post. In other words, the center axis of the supplemental post is not aligned with the center axis of the existing post.

[0020] The coaxial supplementary post does not require a dedicated installation space since the coaxial supplementary post is provided at the same position as the existing post. Accordingly, even when another supplemental post (i.e., independent supplementary post) cannot be separately installed between the existing posts, or, when the number of the supplemental post is limited even if the supplemental post can be installed, the coaxial supplementary post can be installed without any difficulty.

[0021] Moreover, since the post body is formed by stacking a plurality of post cylinders, a length of each of the post cylinders can be sufficiently shorter than that of the post body. Accordingly, delivery of the post cylinders into the hot-blast stove and the operation inside the hot-blast stove can be conducted without any difficulty.

[0022] The post cylinders can be connected, for instance, by fastening a bolt penetrating flanges respectively formed at open ends of the post cylinders, or by a socket-and-spigot joint structure formed by machining flange surfaces.

[0023] Further, since the height adjustment mechanism is provided, the height of the coaxial supplementary post can be adjusted relative to the existing post, so that a load of the metal grille applied to the existing post can be reliably shifted to the coaxial supplementary post.

[0024] For instance, if the coaxial supplementary post shorter than the existing posts is provided outside the existing post, and subsequently, the height of the coaxial supplementary post is increased by the height adjustment mechanism, the load of the metal grille applied to the existing post can be shifted to the coaxial supplementary post the instant the coaxial supplementary post becomes longer than the existing post. Such a coaxial supplementary post can serve as the supplemental post for the existing post.

[0025] A usable height adjustment mechanism is exemplified by a structure of adjusting the height of the coaxial supplementary post by hammering metal wedges from an outside, and a structure of adjusting the height of the coaxial supplementary post using a jack bolt. The height adjustment mechanism can be provided between the post body and the metal grille, in the middle of the post body, or between the post body and the hearth surface.

[0026] In the above arrangement, each of the post cylinders preferably includes a plurality of circumferentially divided post members.

[0027] With this arrangement, the circumferentially divided post members are placed in the respective directions along the periphery of the existing post and are mutually connected along a circumferential direction, so that the post body covering the existing post can be formed.

[0028] The circumferentially divided post members are exemplified by post members provided by dividing each of the post cylinders in half and each having a center angle of 180 degrees (i.e., connection of two semicylindrical pieces), post members provided by dividing each of the post cylinders in thirds and each having a center angle of 120 degrees, post members provided by dividing each of the post cylinders in fourths and each having a center angle of 90 degrees. For instance, the circumferentially divided post members may be a combination of

a single post member having a center angle of 180 degrees and two post members each having a center angle of 90 degrees.

[0029] The post members can be circumferentially connected, for instance, by fastening a bolt penetrating flanges formed on the respective post members.

[0030] In the above arrangement, it is preferable that the post cylinders each have a cylindrical shape and the post members each have a semicylindrical shape provided by dividing a cylindrical plane in half.

[0031] With this arrangement, the post body can be formed into a typical cylinder and each of the post members divided in half has the center angle of 180 degrees. Accordingly, the post body can be formed with the minimum number of the post members. However, the post body may have a polygonal shape such as quadrangle and hexagon.

[0032] In the above arrangement, a heat insulation material is preferably provided between the post body and the existing post.

[0033] Since the heat insulation material is provided in the above arrangement, when the hot-blast stove works, the temperature difference is caused between the outer coaxial supplementary post and the inner existing post. With use of the difference in thermal expansion therebetween, the loads can be shifted from the existing post to the coaxial supplementary post.

[0034] Specifically, since the heat insulation material is interposed between the coaxial supplementary post (on the outer side) and the existing post (on the inner side), heat transmitted from the outside while the hot-blast stove is in operation is sufficiently transmitted to the outer coaxial supplementary post, but is restrained from reaching the inner existing post. Consequently, the outer coaxial supplementary post reaches a high temperature and exhibits a relatively large thermal expansion, whereas the inner existing post is restrained from raising its temperature and exhibits a relatively small thermal expansion, resulting in generation of a difference in thermal expansion between the coaxial supplementary post and the existing post. When the coaxial supplementary post is disposed in a state immediately before receiving the load of the metal grille, the coaxial supplementary post expands along with the operation of the hot-blast stove, thereby lifting up the metal grille due to the difference in thermal expansion relative to the existing post. This lifting of the metal grille enables the load of the metal grille to be shifted from the existing post to the coaxial supplementary post.

[0035] In the above arrangement, the height adjustment mechanism preferably includes metal wedges to be hammered toward a center axis of the post body from an outside of the post body.

[0036] This arrangement allows the coaxial supplementary post to have a sufficient load intensity and the height adjustment mechanism to have a simple structure.

[0037] The metal wedges are each preferably a steel plate having a taper angle of more than zero degree and less than 10 degrees, the taper angle being defined by a front surface and a rear surface of the steel plate. A plurality of metal wedges can be disposed surrounding the coaxial supplementary post in a manner to be equidistant from each other. For instance, four metal wedges can be disposed at every 90 degree interval.

[0038] In the above arrangement, the height adjustment mechanism further includes a jack bolt erected on the hearth surface and configured to be brought into contact with the post body, in which the metal wedges are hammered between the post body and the hearth surface.

[0039] With this arrangement, the coaxial supplementary post can be set at a basic height by adjusting in advance an upper end height of the jack bolt to a predetermined height from the hearth surface and placing the post body (i.e., the coaxial supplementary post) on the jack bolt. Subsequently, the metal wedges are hammered, whereby the coaxial supplementary posts can be raised from the basic height to a set height.

[0040] In other words, even when a difference between the set height and the hearth surface is large, since the jack bolt can compensate a difference between the hearth surface and the basic height, the metal wedges only need to compensate the balance, i.e., a difference between the basic height and the set height. Accordingly, a size of each of the metal wedges can be reduced and a hammering operation can be reduced to the minimum. Moreover, the basic height to be set by the jack bolt can be easily set in a non-load state before the coaxial supplementary post is placed, so that an operation time can be shortened.

[0041] According to another aspect of the invention, a checker brick-receiving metal includes: a metal grille receiving checker bricks in a hot-blast stove; at least one existing post provided between the metal grille and a hearth surface of the hot-blast stove; and at least one coaxial supplementary post provided outside the at least one existing post in a manner to be coaxial with the at least one existing post; the at least one coaxial supplementary post including: at least one post body provided outside the at least one existing post in a manner to be coaxial with the at least one existing post; and a height adjustment mechanism configured to adjust a height of the at least one post body, in which the at least one post body includes a plurality of post cylinders stacked on each other in a height direction.

[0042] According to the above aspect of the invention, the same advantages as described in the above supplemental post for the checker brick-receiving metal are obtainable.

[0043] In the above arrangement, the at least one coaxial supplementary post includes a plurality of coaxial supplementary posts, and the checker brick-receiving metal further includes an independent supplementary post provided between and distanced from the coaxial supplementary posts, and provided between the metal grille and the hearth surface.

[0044] With this arrangement, since the independent supplementary post is used in addition to the coaxial supplementary post used for reinforcement, stress generating on the existing metal grille is reducible while the maximum temperature at which the existing metal grille is usable is increasable.

[0045] According to still another aspect of the invention, a method of additionally installing a supplementary post to a checker brick-receiving metal, in which the checker brick-receiving metal includes a metal grille receiving checker bricks in a hot-blast stove and an existing post provided between the metal grille and a hearth surface of the hot-blast stove, includes: using a coaxial supplementary post, in which the coaxial supplementary post includes a post body having a plurality of post cylinders stacked in a height direction, and a height adjustment mechanism configured to adjust a height of the post body; and providing the coaxial supplementary post outside the existing post in a manner to be coaxial with the existing post.

[0046] According to the above aspect of the invention, the same advantages as described in the above supplemental post for the checker brick-receiving metal are obtainable.

[0047] In the above method, it is preferable to thermally expand the coaxial supplementary post more than the existing post during operation of the hot-blast stove to lead the coaxial supplementary post to receive a larger load of the metal grille than a load received by the existing post.

[0048] With this arrangement, the load of the metal grille can be shifted from the existing post to the coaxial supplementary post with use of the difference in thermal expansion in the above-described supplemental post for the checker brick-receiving metal.

[0049] With this arrangement, since the coaxial supplementary post disposed coaxially with the existing post is used, the supplemental post can be additionally installed even when a setting space is limited. As a result, the supplemental post for the checker brick-receiving metal, the checker brick-receiving metal, and the method of additionally installing the supplemental post, which are capable of increasing a heat storage amount of checker bricks to increase a temperature, reduce a running cost, and shorten a construction period, can be provided.

BRIEF DESCRIPTION OF DRAWING(S)

[0050]

Fig. 1 is a schematic illustration showing an arrangement of a hot-blast stove in a first exemplary embodiment of the invention.

Fig. 2 is a schematic illustration showing a checker brick-receiving metal in the first exemplary embodiment.

Fig. 3 is a schematic illustration showing a planar layout of existing posts, coaxial supplementary posts and independent supplementary posts in the first exemplary embodiment.

Fig. 4 is a vertical cross-sectional view of the existing post in the first exemplary embodiment.

Fig. 5 is a transverse cross-sectional view of the existing post in the first exemplary embodiment.

Fig. 6 is a vertical cross-sectional view of the coaxial supplementary post in the first exemplary embodiment.

Fig. 7 is a transverse cross-sectional view of the coaxial supplementary post in the first exemplary embodiment.

Fig. 8 is an exploded perspective view of a post cylinder of the coaxial supplementary post in the first exemplary embodiment.

Fig. 9 is a cross-sectional view of a lower end of the coaxial supplementary post in the first exemplary embodiment.

Fig. 10 is a vertical cross-sectional view of the independent supplementary post in the first exemplary embodiment.

Fig. 11 is a transverse cross-sectional view of the independent supplementary post in the first exemplary embodiment.

Fig. 12 is a schematic illustration showing a checker brick-receiving metal in a second exemplary embodiment of the invention.

Fig. 13 is a schematic illustration showing a planar layout of existing posts and coaxial supplementary posts in the second exemplary embodiment.

DESCRIPTION OF EMBODIMENT(S)

[0051] Embodiments of the invention will be described below in detail with reference to the drawings.

First Exemplary Embodiment

[0052] As shown in Fig. 1, a blast furnace 1 configured to produce pig iron is connected with a hot-blast stove 2 configured to supply hot blast. Although a single hot-blast stove 2 is shown alone in Fig. 1, a plurality of hot-blast stoves 2 are usually provided to a single blast furnace.

[0053] The hot-blast stove 2 includes a combustion chamber 9 and a checker chamber 3. A checker brick-receiving metal 10 is provided on a hearth of the checker chamber 3. Checker bricks 4 for storing heat are layered on the checker brick-receiving metal 10.

[0054] Each of the checker bricks 4 has a substantially hexagonal shape in a plan view and has a plurality of through-holes vertically penetrating itself. The checker bricks 4 are horizontally arranged in a lattice and layered toward near a furnace top of the hot-blast stove 2 from the checker brick-receiving metal 10.

[0055] The through-holes of the checker bricks 4 communicate with each other. Air can circulate between the hearth of the checker chamber 3 and the furnace top through the through-holes.

[0056] A duct 5 is connected to a lower lateral surface of the hot-blast stove 2. A space in the checker brick-receiving metal 10 is defined as a ventilation space 6. The duct 5 is in communication with the through-holes of the checker bricks 4 through the ventilation space 6.

Checker Brick-Receiving Metal 10

[0057] As shown in Fig. 2, the checker brick-receiving metal 10 includes: a metal grille 20, an upper surface of which supports the checker bricks 4; and a girder 30 supporting a lower surface of the metal grille 20. Further, the checker brick-receiving metal 10 further includes: a plurality of existing posts 40 and a plurality of coaxial supplementary posts 50, both of which support the girder 30; and a plurality of independent supplementary posts 60 supporting the metal grille 20. The metal grille 20, girder 30, existing posts 40, coaxial supplementary posts 50 and independent supplementary posts 60 are made of cast iron. However, other materials such as refractories, a steel plate and cast steel are usable as long as the other materials have a satisfactory heatproof temperature.

[0058] The metal grille 20 is shaped in a flat plate and horizontally extends over the hearth inside the hot-blast stove 2. A lot of ventilation holes vertically penetrate the metal grille 20 and are in one-to-one communication with the through-holes of the checker bricks 4.

[0059] The girder 30 is defined by a plurality of beams horizontally supported and provided along the lower surface of the metal grille 20. The girder 30 supports the lower surface of the metal grille 20.

[0060] The existing posts 40 are spaced apart from each other with a predetermined distance along a longitudinal direction of the girder 30. Upper ends of the existing posts 40 support the girder 30. Lower ends of the existing posts 40 are fixed to the hearth of the hot-blast stove 2 and are buried in heat-resistant concrete 22. Foundation bricks 23 are laid over the heat-resistant concrete 22.

[0061] The coaxial supplementary posts 50 are respectively provided outside the existing posts 40 in a manner to be coaxial with the existing posts 40. Upper ends of the coaxial supplementary posts 50 support the girder 30. Lower ends of the coaxial supplementary posts 50 are fixed to the heat-resistant concrete 22 and buried in the foundation bricks 23.

[0062] The independent supplementary posts 60 are spaced apart with a predetermined distance from each other, the existing posts 40 and the coaxial supplementary posts 50. Upper ends of the independent supplementary posts 60 support the metal grille 20. Lower ends of the independent supplementary posts 60 are fixed to the heat-resistant concrete 22 and buried in the foundation bricks 23.

[0063] As shown in Fig. 3, since the existing posts 40 are provided along the girder 30 on the hearth of the hot-blast stove 2, the existing posts 40 are linearly arranged. The coaxial supplementary posts 50 are coaxial with (i.e., at the same position as) the respective existing posts 40. Accordingly, the arrangement of the coaxial supplementary posts 50 on the hearth becomes a linear arrangement in line with the arrangement of the existing posts 40.

[0064] In contrast, the independent supplementary posts 60 are arrangement independent of the girder 30. The independent supplementary posts 60 are each provided at an intermediate position between the existing posts 40 in order to keep a distance from the surroundings. For this reason, most of the independent supplementary posts 60 are linearly arranged. However, the independent supplementary posts 60 are not always linearly arranged at or near the periphery of the hot-blast stove 2.

[0065] The existing posts 40, coaxial supplementary posts 50 and independent supplementary posts 60 will be described in detail below.

Existing Posts 40

[0066] The existing posts 40 are installed at the time of the construction of the hot-blast stove 2 and, as shown in Figs. 4 and 5, are each in a form of an annular steel pipe that is seamless across the entire length.

[0067] As shown in Fig. 4, the lower ends of the existing posts 40 are buried in the heat-resistant concrete 22 on the hearth of the hot-blast stove 2. Before the lower ends of the existing posts 40 are buried in the heat-resistant concrete 22, a fixing height of each of the existing posts 40 is adjusted.

[0068] A lower end plate 41 is fixed to each of the lower ends of the existing posts 40. A furnace shell 221 of the hearth of the hot-blast stove (hereinafter, also referred to as a "hot-blast-stove-hearth furnace shell 221") is provided on the hearth of the hot-blast stove 2. Metal wedges 42 are provided between the lower end plate 41 and the hot-blast-stove-hearth furnace shell 221. The height of each of the existing posts 40 can be adjusted depending on a degree to which the metal wedges 42 are hammered. Concrete is cast after such a height adjustment, so that the existing posts 40 are provided at a predetermined height with the lower ends thereof being buried in the heat-resistant concrete 22.

[0069] The existing posts 40 are installed in the following procedure.

[0070] Firstly, the metal wedges 42 are provided on the hot-blast-stove-hearth furnace shell 221, the lower end plate 41 is placed on the metal wedges 42, and each of the existing posts 40 is vertically held on the lower end plate 41.

[0071] Next, the metal wedges 42 are hammered from the periphery of each of the existing posts 40 to adjust an upper end height of each of the existing posts 40 to a predetermined height.

[0072] After the height of each of the existing posts 40 reaches the predetermined height, concrete is cast in a manner to cover the lower end plate 41 and the metal

wedges 42, thereby forming heat-resistant concrete 22. By this operation, the lower ends of the existing posts 40 are fixed to the hearth.

[0073] After the existing posts 40 are fixed to the hearth, the foundation bricks 23 are laid over a surface of the heat-resistant concrete 22 surrounding the existing posts 40. Further, the girder 30 and the metal grille 20 are supported on the upper ends of the existing posts 40.

[0074] By the above operations, the existing posts 40 supporting the metal grille 20 through the girder 30 are formed.

[0075] The hot-blast stove 2 can work with only the existing posts 40 supporting the girder 30 and the metal grille 20. However, a supplemental post is provided, for instance, in order to increase a heat storage amount of the checker bricks 4 to increase a temperature inside the hot-blast stove 2.

[0076] In the exemplary embodiment, the coaxial supplementary posts 50 and the independent supplementary posts 60 are provided as the supplemental post.

Coaxial Supplementary Posts 50

[0077] The coaxial supplementary posts 50 are additionally installed in the hot-blast stove 2. As shown in Fig. 6, each of the coaxial supplementary posts 50 includes: a steel-made post body 51 coaxially provided outside each of the existing posts 40; and a height adjustment mechanism 59 configured to adjust a height of the post body 51. The post body 51 includes a plurality of post cylinders 52 stacked on each other in a height direction.

[0078] As shown in Figs. 7 and 8, each of the post cylinders 52 is provided by a pair of half cylindrical post members 53 each having a center angle of 180 degrees. In order to attach the post members 53 to each other, flanges 531 are formed to the respective post members 53 and the flange 531 are fastened by bolts 532.

[0079] Each of the existing posts 40 is sandwiched between a pair of the post member 53 when the pair of the post member 53 are put together, so that each of the post cylinders 52 is coaxially provided outside each of the existing posts 40.

[0080] A heat insulation material 54 is interposed between the post members 53 and the corresponding existing posts 40.

[0081] The heat insulation material 54 may be attached in advance on an inner surface of each of the post members 53, or may be wrapped over an outer surface of each of the existing posts 40. Alternatively, the heat insulation material 54 may be pushed into a gap formed between the existing posts 40 and the corresponding post members 53 after the post members 53 are installed. The heat insulation material 54 may be a sheet-shaped or a mat-shaped component, or may be formed by spraying.

[0082] The heat insulation material 54 is not necessarily used when a temperature difference enough to cause an expansion difference between the coaxial supplementary posts 50 and the existing posts 40 are generated between the coaxial supplementary posts 50 and the existing posts 40. For instance, a thickness of each of the coaxial supplementary posts 50 may be increased, or alternatively, other methods such as increasing the distance between the coaxial supplementary posts 50 and the existing posts 40 may be used.

[0083] Each of the post cylinders 52 has arc-shaped flanges 521 (i.e., an upper flange and a lower flange) along upper and lower edges. The upper flange of each of the post cylinders 52 is fastened by a bolt 522 to the lower flange of an adjacent one of the post cylinders 52 to be mutually connected, thereby forming the post body 51.

[0084] A top end member 58 is connected to the uppermost one of the post cylinders 52 forming the post body 51. The post body 51 is connected to the girder 30 through the top end member 58.

[0085] As shown in Fig. 6, when the coaxial supplementary posts 50 are installed, a part of the foundation bricks 23 surrounding the existing posts 40 is removed to expose the heat-resistant concrete 22. The height adjustment mechanism 59 is formed between the lowermost one of the post cylinders 52 forming the post body 51 and the heat-resistant concrete 22.

[0086] As shown in Fig. 9, a base plate 222 is laid over the surface of the heat-resistant concrete 22. Metal wedges 591, a jack bolt 592, and fixing bolts 593 are provided to the base plate 222.

[0087] The metal wedges 591 are each a steel piece having a taper angle more than zero degree and less than 10 degrees and is capable of adjusting a height of the post body by being hammered from the outside and capable of receiving a large load.

[0088] The jack bolt 592 is screwed into a nut fixed to the base plate 222. By rotating the jack bolt 592, a height of the jack bolt 592 at its head can be adjusted. By this height adjustment, a height position of the lowermost one of the post cylinders 52 can be adjusted, thereby determining a height position of the corresponding one of the coaxial supplementary posts 50.

[0089] A lower portion of each of the fixing bolts 593 is buried and fixed in the heat-resistant concrete 22. Each of the fixing bolts 593 is inserted into a bolt hole of the base plate 222 and a bolt hole of the flange 521 of the lowermost one of the post cylinders 52 and is screwed into a nut to be fastened, so that the post cylinders 52 can be fixed to the heat-resistant concrete 22.

[0090] The coaxial supplementary posts 50 are installed in the following procedure.

[0091] Firstly, the part of the foundation bricks 23 surrounding the existing posts 40, where the coaxial supplementary posts 50 are to be installed, is removed to expose the heat-resistant concrete 22 (see Fig. 6).

[0092] Subsequently, the base plate 222 is laid over the exposed surface of the heat-resistant concrete 22 (see Fig. 9). The metal wedges 591, the jack bolt 592, and the fixing bolts 593 are provided to the base plate

222.

[0093] Next, the post body 51 is constructed on the jack bolt 592.

[0094] Firstly, the top end member 58 to be placed at the uppermost position in the post body 51 (see Fig. 6) is delivered onto the jack bolt 592 and lifted up with a crane to secure a space under the top end member 58, the space being sufficient for placing one of the post cylinders 52.

[0095] Subsequently, under the top end member 58, a pair of the post members 53 are combined with one of the existing posts 40 interposed therebetween (see Fig. 8), thereby forming a second one of the post cylinders 52. At this time, the heat insulation material 54 is sandwiched between each of the existing posts 40 and the corresponding one of post members 53 (see Fig. 7). After the second one of the post cylinders 52 is formed, the crane is again raised to secure a space for another one of the post cylinders 52.

[0096] The assembly and lifting up of the post cylinders 52 as described above are repeated and a predetermined number of the post cylinders 52 are mutually connected, so that the post body 51 is formed.

[0097] After the formation of the post body 51, the jack bolt 592 is adjusted to a predetermined height. Then, the crane lifting the post body 51 is lowered and the lowermost one of the post cylinders 52 is supported on the jack bolt 592 and fixed to the base plate with the fixing bolts 593. At this time, the metal wedges 591 are positioned so as to be substantially in contact with the flanges 521 of the post cylinders 52.

[0098] In the post body 51 in an assembled state, a slight gap is formed between an upper surface of the top end member 58 and a lower surface of the girder 30. The loads of the metal grille 20 and the girder 30 are received exclusively by the existing posts 40, and not received by the coaxial supplementary posts 50.

[0099] The above-described gap between the upper surface of the top end member 58 and the lower surface of the girder 30 is designed, at a design stage, to be smaller than an adjustable margin by the height adjustment mechanism 59, in other words, an adjustable range by the metal wedges 591.

[0100] By the height adjustment of the post body 51 using the height adjustment mechanism 59, the loads of the metal grille 20 and the girder 30 are received also by the coaxial supplementary posts 50 in addition to the existing posts 40.

[0101] Specifically, the metal wedges 591 are hammered from the outside of the coaxial supplementary posts 50 to lift up the post body 51, thereby decreasing the gap between the upper surface of the top end member 58 and the lower surface of the girder 30. Eventually, the gap is eliminated, so that the upper surface of the top end member 58 is brought into contact with the lower surface of the girder 30. When the metal wedges 591 are farther hammered, the girder 30 becomes supported by the post body 51.

[0102] In this stage, the existing posts 40 may still receive the load of the girder 30. The load applied to the existing posts 40 is further decreased or eliminated by a difference in thermal expansion between the existing posts 40 and the coaxial supplementary posts 50, the thermal expansion caused by heating the existing posts 40 and the coaxial supplementary posts 50 when the hot-blast stove 2 restarts working.

Independent Supplementary Posts 60

[0103] The independent supplementary posts 60 are additionally provided to a portion of the hot-blast stove 2 defined between the existing posts 40 and including no girder 30 therein. As shown in Fig. 10, each of the independent supplementary posts 60 includes: a steel-made post body 61; and a height adjustment mechanism 69 configured to adjust a height of the post body 61. The post body 61 includes a plurality of post cylinders 62 stacked on each other in a height direction.

[0104] As shown in Figs. 10 and 11, each of the post cylinders 62 is provided by a cylindrical post member with flanges 621 (i.e., an upper flange and a lower flange) provided at upper and lower open edges.

[0105] The upper flange of each of the post cylinders 62 is fastened by a bolt 622 to the lower flange of an adjacent one of the post cylinders 62 to be mutually connected, thereby forming the post body 61.

[0106] A top end member 68 is connected to the uppermost one of the post cylinders 62 forming the post body 61. The post body 61 is directly connected to the metal grille 20 through the top end member 68.

[0107] As shown in Fig. 10, when the independent supplementary posts 60 are installed, a part of the foundation bricks 23, where the independent supplementary posts 60 are installed, is removed to expose the heat-resistant concrete 22. The height adjustment mechanism 69 using metal wedges 691 is formed between the lowermost one of the post cylinders 62 forming the post body 61 and the heat-resistant concrete 22.

[0108] In the same manner as the above-described height adjustment mechanism 59 of the coaxial supplementary posts 50 (see Fig. 9), the height adjustment mechanism 69 is used for assembling a series of the post body 6 by repeating the operation of placing the top end member 68 and the plurality of post cylinders 62 one by one and lifting by a crane. Here, the overlapping description on these operations is omitted.

[0109] By the above operation, the post cylinders 62 and the top end member 68 are assembled into the post body 61. In the post body 61 in an assembled state, a slight gap is formed between an upper surface of the top end member 68 and the lower surface of the metal grille 20. The above-described gap is designed, at a design stage, to be smaller than an adjustable margin by the height adjustment mechanism 69, in other words, an adjustable range by the metal wedges 691.

[0110] The metal wedges 691 are hammered from the

outside of the independent supplementary posts 60 to lift up the post body 61, thereby decreasing the gap between the upper surface of the top end member 68 and the lower surface of the metal grille 20. Eventually, the gap is eliminated, so that the upper surface of the top end member 68 is brought into contact with the lower surface of the metal grille 20. When the metal wedges 691 are farther hammered, the metal grille 20 becomes supported by the post body 61.

Additional Installation Procedure of Supplemental Post

[0111] In the exemplary embodiment, the installation procedure of the existing posts 40 when constructing the hot-blast stove 2, and the installation procedure of the coaxial supplementary posts 50 and the independent supplementary posts 60 when additionally installing a supplemental post are the same as described above.

[0112] An overall operational procedure when additionally installing the supplemental post will be described.

[0113] The additional installation of the supplemental post to the hot-blast stove 2 is conducted during a period when air stops blowing into the blast furnace. In order to additionally install the supplemental post, the hot-blast stove 2 in operation is initially stopped and is cooled until an internal temperature of the hot-blast stove 2 reaches a temperature at which a worker can work inside the hot-blast stove 2.

[0114] Next, the worker enters the hot-blast stove 2 from a manhole 8 (see Figs. 2 and 3) and, at a portion of the hearth surface 21 where the coaxial supplementary posts 50 and the independent supplementary posts 60 are to be installed, digs the foundation bricks 23 below the hearth surface 21 to expose the heat-resistant concrete 22. Wastes of the foundation bricks 23 are delivered out through the manhole 8.

[0115] Subsequently, the material for the coaxial supplementary posts 50 and independent supplementary posts 60, specifically, components of the post members 53, the post cylinders 62 and the height adjustment mechanisms 59, 69 are delivered in through the manhole 8 and assembled.

[0116] After the assembly of the post body 51 of each of the coaxial supplementary posts 50 and the post body 61 of each of the independent supplementary posts 60, the coaxial supplementary posts 50 and the independent supplementary posts 60 start receiving the loads of the girder 30 and the metal grille 20 by operating the height adjustment mechanisms 59, 69.

[0117] Here, after the worker finishes the operation in the hot-blast stove 2 and exits the hot-blast stove 2, the operation of the hot-blast stove 2 is restarted. Due to internal heat caused by the operation, the existing posts 40, the coaxial supplementary posts 50, and the independent supplementary posts 60 are thermally expanded. However, a thermal expansion amount of each of the existing posts 40 is small since each of the existing posts 40 is covered with the heat insulation material 54 to cause a relatively small increase in a temperature of the existing posts 40. In contrast, thermal expansion amounts of the coaxial supplementary posts 50 and the independent supplementary posts 60 are large, so that the coaxial supplementary posts 50 and the independent supplementary posts 60 further increasingly receive the loads of the girder 30 and the metal grille 20. As a result, the load applied to the existing posts 40 is decreased or eliminated. This state can be selected by adjusting the distance from the existing posts 40 to the coaxial supplementary posts 50 and the independent supplementary posts 60 in designing and installing the existing posts 40, the coaxial supplementary posts 50, and the independent supplementary posts 60.

Advantages of First Exemplary Embodiment

[0118] According to the first exemplary embodiment, the post body 51 covering the periphery of the corresponding one of the existing posts 40 can form each of the coaxial supplementary posts 50 coaxial with the corresponding one of the existing posts 40.

[0119] The coaxial supplementary posts 50 do not require a dedicated installation space since the coaxial supplementary posts 50 are provided at the same positions as those of the corresponding existing posts 40. Accordingly, even when a supplemental post (i.e., independent supplementary posts 60) cannot be separately installed between the existing posts 40, or, when the number of the supplemental post is limited even if the supplemental post can be installed, the coaxial supplementary posts 50 can be installed without any difficulty.

[0120] Moreover, since the post body 51 is formed by stacking a plurality of post cylinders 52, a length of each of the post cylinders 52 can be sufficiently shorter than that of the post body 51. Accordingly, delivery of the post cylinders 52 into the hot-blast stove 2 and the operation inside the hot-blast stove 2 can be conducted without any difficulty.

[0121] Further, since the height adjustment mechanism 59 is provided, the height of the coaxial supplementary posts 50 can be adjusted relative to the existing posts 40, so that the loads of the metal grille 20 and the girder 30 applied to the existing posts 40 can be reliably shifted to the coaxial supplementary posts 50.

[0122] For instance, if the coaxial supplementary posts 50 shorter (i.e., in a relatively lower height) than the existing posts 40 are provided outside the existing posts 40, and subsequently, the height of the coaxial supplementary posts 50 is increased by the height adjustment mechanism 59, the load of the metal grille 20 applied to the existing posts 40 can be shifted to the coaxial supplementary posts 50 the instant the coaxial supplementary posts 50 become longer than the existing posts 40. Such coaxial supplementary posts 50 can serve as the supplemental posts for the existing posts 40.

[0123] In the exemplary embodiment, the post cylinders 52 are formed by a plurality of circumferentially di-

vided post members 53. With this arrangement, the circumferentially divided post members 53 are placed in the respective directions along the periphery of each of the existing posts 40 and are mutually connected along a circumferential direction, so that the post cylinders 52 and the post body 51 covering each of the existing posts 40 can be formed.

[0124] Particularly, in the exemplary embodiment, the post cylinders 52 each have a cylindrical shape and the post members 53 each have a half cylindrical shape provided by dividing a cylindrical plane in half. With this arrangement, the post body 51 can be formed into a typical cylinder and each of the post members 53 divided in half has the center angle of 180 degrees. Accordingly, the post body 51 can be formed with the minimum number of the post members.

[0125] In the exemplary embodiment, the heat insulation material 54 is interposed between the existing posts 40 and the corresponding coaxial supplementary posts 50. With this arrangement, when the hot-blast stove 2 is in operation, the temperature difference is caused between the coaxial supplementary posts 50 provided on the outer side and the existing posts 40 provided on the inner side. With use of the difference in thermal expansion therebetween, the loads can be shifted from the existing posts 40 to the coaxial supplementary posts 50.

[0126] In the exemplary embodiment, the height adjustment mechanism 59 includes the metal wedges 591 to be hammered toward the center axis of the post body 51 from the outside of the post body 51. With use of the above-described metal wedges 591, the coaxial supplementary posts 50 can have a sufficient a load intensity and the height adjustment mechanism can have a simple structure.

[0127] In the exemplary embodiment, the height adjustment mechanism 59 also includes, in addition to the above-described metal wedges 591, the jack bolt 592 erected on the base plate 222 of the hearth surface and being capable of being brought into contact with the post body 51. With this arrangement, the coaxial supplementary posts 50 can be set at a basic height by adjusting in advance an upper end height of the jack bolt 592 to a predetermined height from the hearth surface 21 and placing the post body 51 on the jack bolt 592. Subsequently, the metal wedges 591 are hammered, whereby the coaxial supplementary posts 50 can be raised from the basic height to a set height.

[0128] In other words, even when a difference between the set height and the hearth surface is large, since the jack bolt 592 can compensate a difference between the hearth surface and the basic height, the metal wedges 591 are only required to compensate the balance, i.e., a difference between the basic height and the set height. Accordingly, a size of each of the metal wedges 591 can be reduced and a hammering operation can be reduced to the minimum. Moreover, the basic height to be set by the jack bolt 592 can be easily set in a non-load state before the coaxial supplementary posts 50 are placed, so that an operation time can be shortened.

Second Exemplary Embodiment

[0129] In the first exemplary embodiment, the coaxial supplementary posts 50 and the independent supplementary posts 60 are used in combination as the supplemental post. However, in a second exemplary embodiment, only the coaxial supplementary posts 50 are used as the supplemental post and the independent supplementary posts 60 are not provided.

[0130] As shown in Figs. 12 and 13, a checker brick-receiving metal 10A is provided on the hearth of the hot-blast stove 2.

[0131] In the checker brick-receiving metal 10A, in the same manner as in the checker brick-receiving metal 10 in the first exemplary embodiment, the girder 30 and the metal grille 20 are supported only by the existing posts 40 at the time of construction of the hot-blast stove 2.

[0132] When additionally installing the supplemental posts in the checker brick-receiving metal 10A, the coaxial supplementary posts 50 are provided outside the existing posts 40. It should be noted that a supplemental post (the independent supplementary posts 60 in the first exemplary embodiment) is not provided between the existing posts 40.

[0133] The respective structures of the coaxial supplementary posts 50, the existing posts 40, the girder 30, and the metal grille 20 in the second exemplary embodiment are the same as those in the first exemplary embodiment. Accordingly, the overlapping description on these components is omitted.

[0134] Also in the second exemplary embodiment, the advantages by the coaxial supplementary posts 50 are also obtainable. Although the reinforcement by the independent supplementary posts 60 as described in the first exemplary embodiment is not obtained, the structure of the hot-blast furnace can be simplified and a construction period thereof can be shortened when only the coaxial supplementary posts 50 are sufficient for intended performance of the supplemental post provided to the checker brick-receiving metal 10A.

Other Exemplary Embodiment(s)

[0135] It should be understood that the scope of the invention is not limited to the above-described exemplary embodiments but includes modifications and improvements as long as the modifications and improvements are compatible with the invention.

[0136] For instance, the jack bolt 592 is omittable in the height adjustment mechanism 59. In some embodiments, a spacer (e.g., a steel piece) replaces the jack bolt 592 to support the post cylinders 52, and subsequently the metal wedges 591 are hammered to adjust the height.

[0137] The height adjustment mechanism 59 is not limited to a structure using the metal wedges 591. However,

a structure capable of receiving a large load and adjusting the height is desirably the metal wedges 591 or wedge members made of other heat resistant material.

[0138] The post members 53 to be assembled to form the post cylinder 52 are not limited to each have a half cylindrical shape provided by dividing a cylinder in half. However, in some embodiments, each of the post members 53 has a shape provided by dividing a cylinder in thirds or more. However, each of the post members 53 is desirably a shape approximately in half a cylinder since the number of components is increased.

[0139] The post body 51 is not limited to have a circular cross section. However, in some embodiments, the post body 51 has any cross section such as a rectangular cross section. However, the post body 51 desirably has a circular cross section in consideration of a directional evenness.

[0140] The hot-blast stove 2 to which the invention is applicable may be of an internal-combustion type, an external-combustion type, or furnace-top combustion type. The invention is usable in any type of a hot-blast stove using the checker brick-receiving metal supporting the checker bricks.

[0141] The material for the coaxial supplementary posts 50 and the independent supplementary posts 60 is not limited to cast iron. Any high-temperature-resistant materials such as refractories, a steel plate and cast steel are usable.

INDUSTRIAL APPLICABILITY

[0142] The invention is applicable to a supplemental post for a checker brick-receiving metal supporting checker bricks in a checker chamber of a hot-blast stove, the checker brick-receiving metal, and a method of additionally installing a post.

EXPLANATION OF CODE(S)

[0143] 1...blast furnace, 2...hot-blast stove, 3...checker chamber, 4...checker brick, 5...duct, 6...ventilation space, 8...manhole, 9...combustion chamber, 10, 10A...checker brick-receiving metal, 20... metal grille, 21...hearth surface, 22...heat-resistant concrete, 221...hot-blast-stove-hearth furnace shell, 222...base plate, 23...foundation brick, 30...girder, 40...existing post, 41...lower end plate, 42...metal wedge, 50...coaxial supplementary post, 51...post body, 52...post cylinder, 521, 531...flange, 522, 532...bolt, 53...post member, 54...heat insulation material, 58...top end member, 59...height adjustment mechanism, 591...metal wedge, 592...jack bolt, 593...fixing bolt, 60...independent supplementary post, 61...post body, 62...post cylinder, 621...flange, 622...bolt, 68...top end member, 69...height adjustment mechanism, 691 ...metal wedge.

Claims

1. A supplemental post for a checker brick-receiving metal, the supplemental post provided between a hearth surface and a metal grille receiving checker bricks in a hot-blast stove, the supplemental post comprising:

   a post body provided outside an existing post provided between the metal grille and the hearth surface in a manner to be coaxial with the existing post; and
   a height adjustment mechanism configured to adjust a height of the post body, wherein

   the post body comprises a plurality of post cylinders stacked on each other in a height direction.

2. The supplemental post according to claim 1, wherein each of the post cylinders comprises a plurality of circumferentially divided post members.

3. The supplemental post according to claim 2, wherein the post cylinders each have a cylindrical shape and the post members each have a semicylindrical shape provided by dividing a cylindrical plane in half.

4. The supplemental post according to any one of claims 1 to 3, further comprising:

   a heat insulation material provided between the post body and the existing post.

5. The supplemental post according to any one of claims 1 to 4, wherein
   the height adjustment mechanism comprises metal wedges to be hammered toward a center axis of the post body from an outside of the post body.

6. The supplemental post according to claim 5, wherein the height adjustment mechanism further comprises:
   a jack bolt erected on the hearth surface and configured to be brought into contact with the post body,
   wherein the metal wedges are hammered between the post body and the hearth surface.

7. A checker brick-receiving metal comprising:

   a metal grille receiving checker bricks in a hot-blast stove;
   at least one existing post provided between the metal grille and a hearth surface of the hot-blast stove; and
   at least one coaxial supplementary post provided outside the at least one existing post in a manner to be coaxial with the at least one existing post;
   the at least one coaxial supplementary post

comprising:

at least one post body provided outside the at least one existing post in a manner to be coaxial with the at least one existing post; and
a height adjustment mechanism configured to adjust a height of the at least one post body, wherein

the at least one post body comprises a plurality of post cylinders stacked on each other in a height direction.

8. The checker brick-receiving metal according to claim 7, wherein
the at least one coaxial supplementary post comprises a plurality of coaxial supplementary posts, and
the checker brick-receiving metal further comprises an independent supplementary post provided between and distanced from the coaxial supplementary posts, and provided between the metal grille and the hearth surface.

9. A method of additionally installing a supplementary post to a checker brick-receiving metal, the checker brick-receiving metal comprising: a metal grille receiving checker bricks in a hot-blast stove; and an existing post provided between the metal grille and a hearth surface of the hot-blast stove, the method comprising:

using a coaxial supplementary post, the coaxial supplementary post comprising: a post body comprising a plurality of post cylinders stacked in a height direction; and a height adjustment mechanism configured to adjust a height of the post body; and
providing the coaxial supplementary post outside the existing post in a manner to be coaxial with the existing post.

10. The method according to claim 9, further comprising:

thermally expanding the coaxial supplementary post more than the existing post during operation of the hot-blast stove to lead the coaxial supplementary post to receive a larger load of the metal grille than a load received by the existing post.

FIG. 1

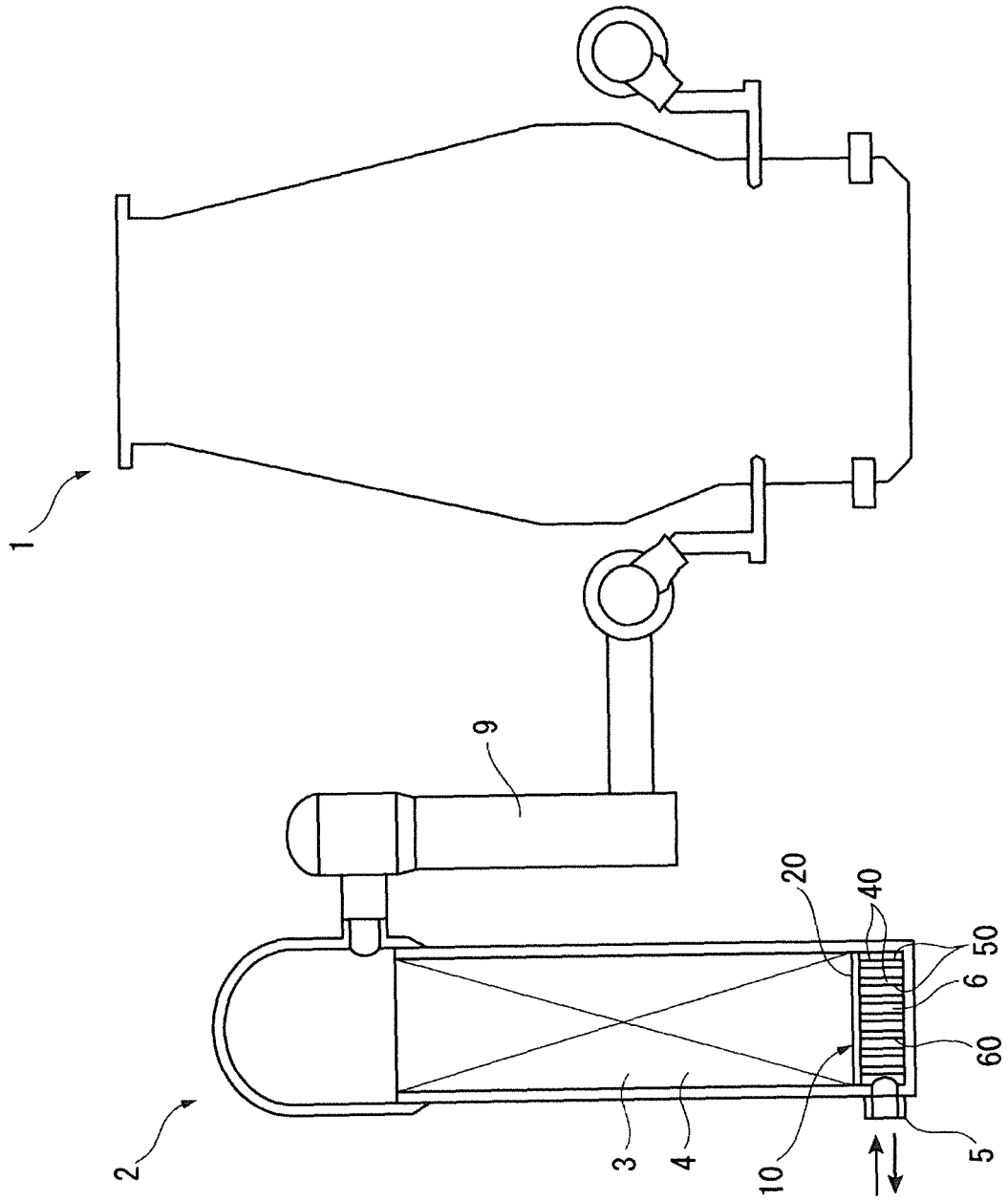


FIG. 2

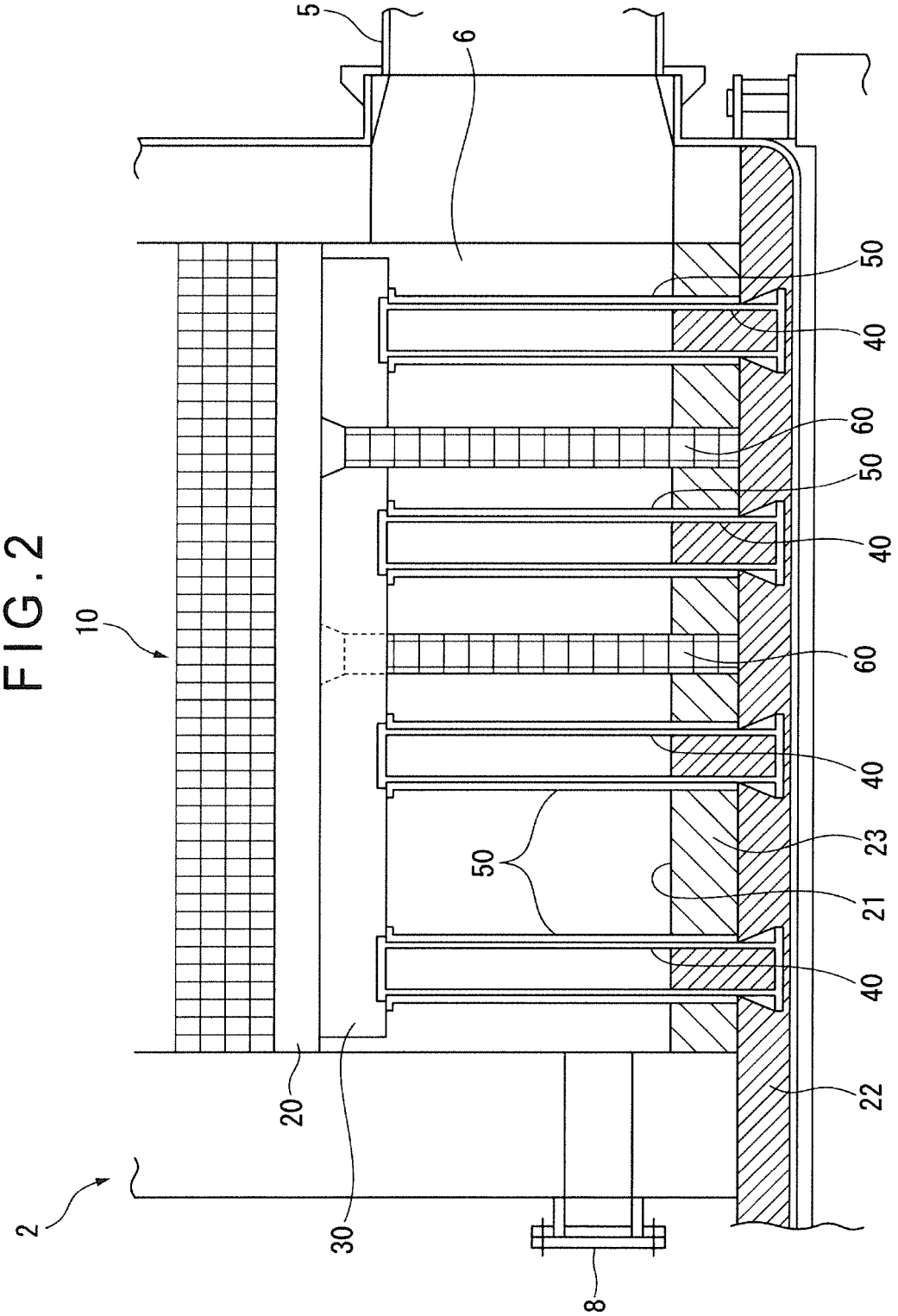


FIG. 3

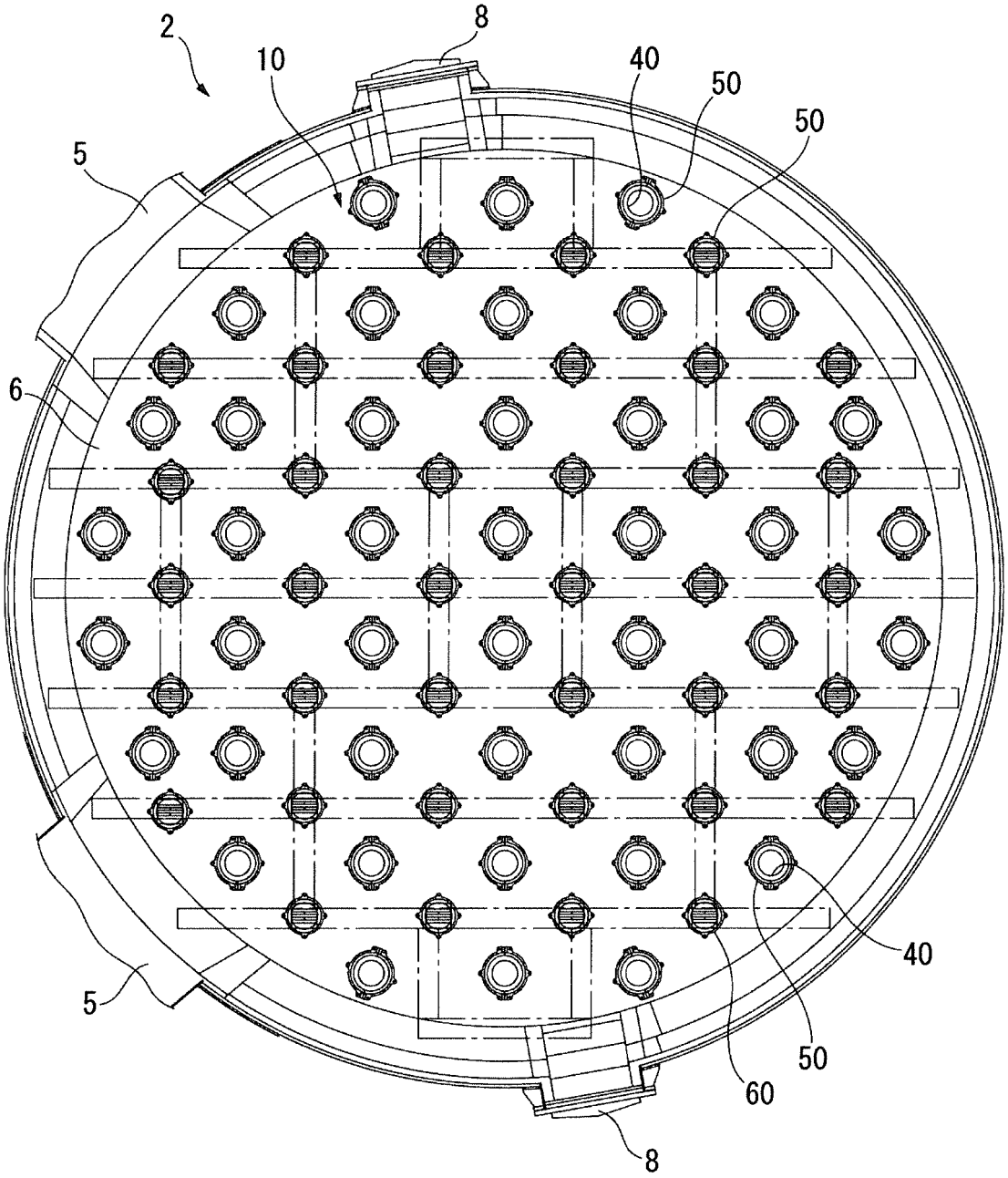


FIG. 4

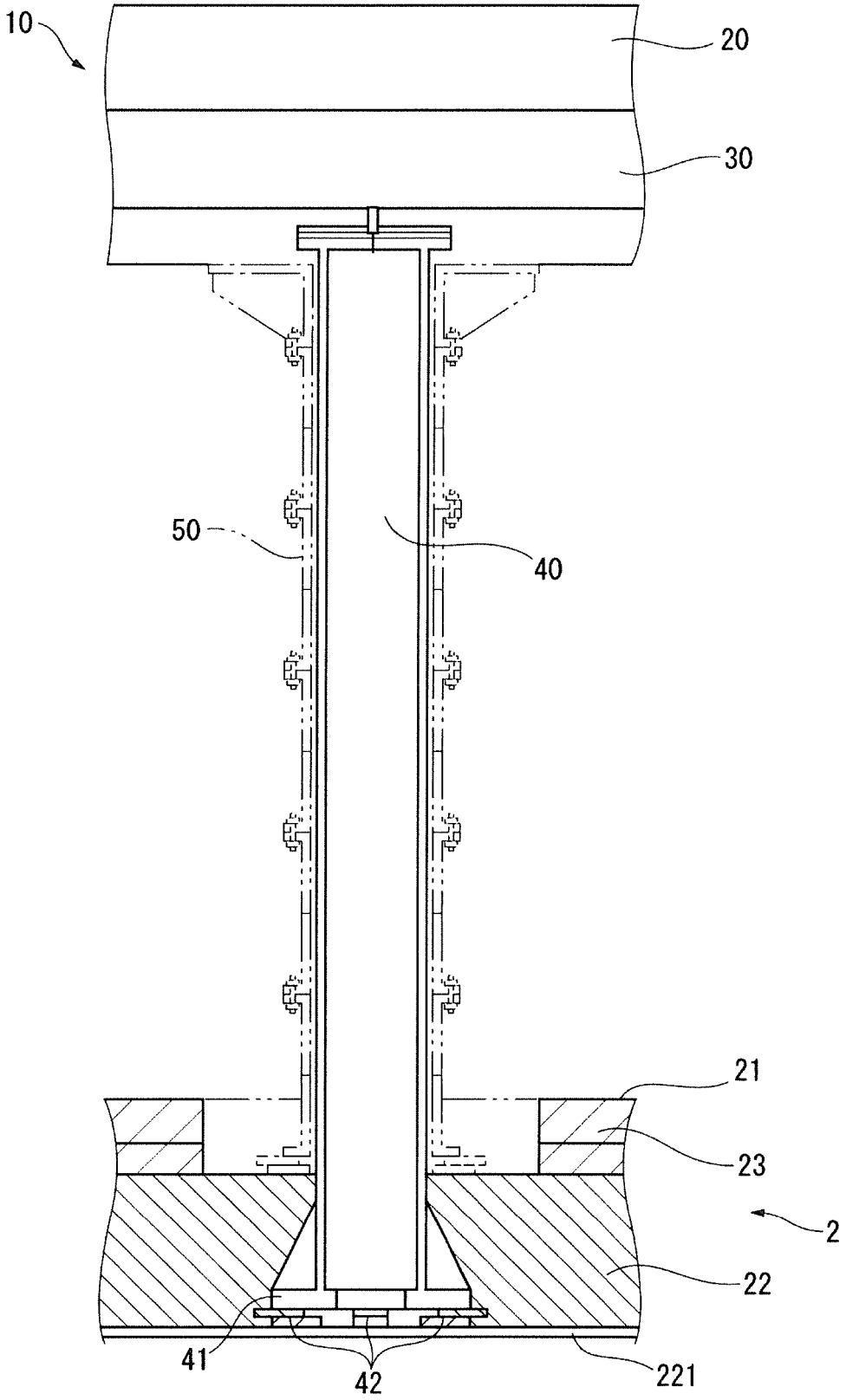


FIG. 5

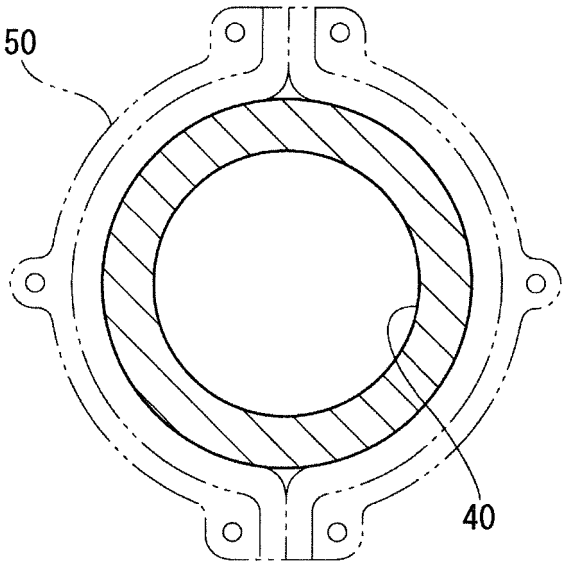


FIG. 6

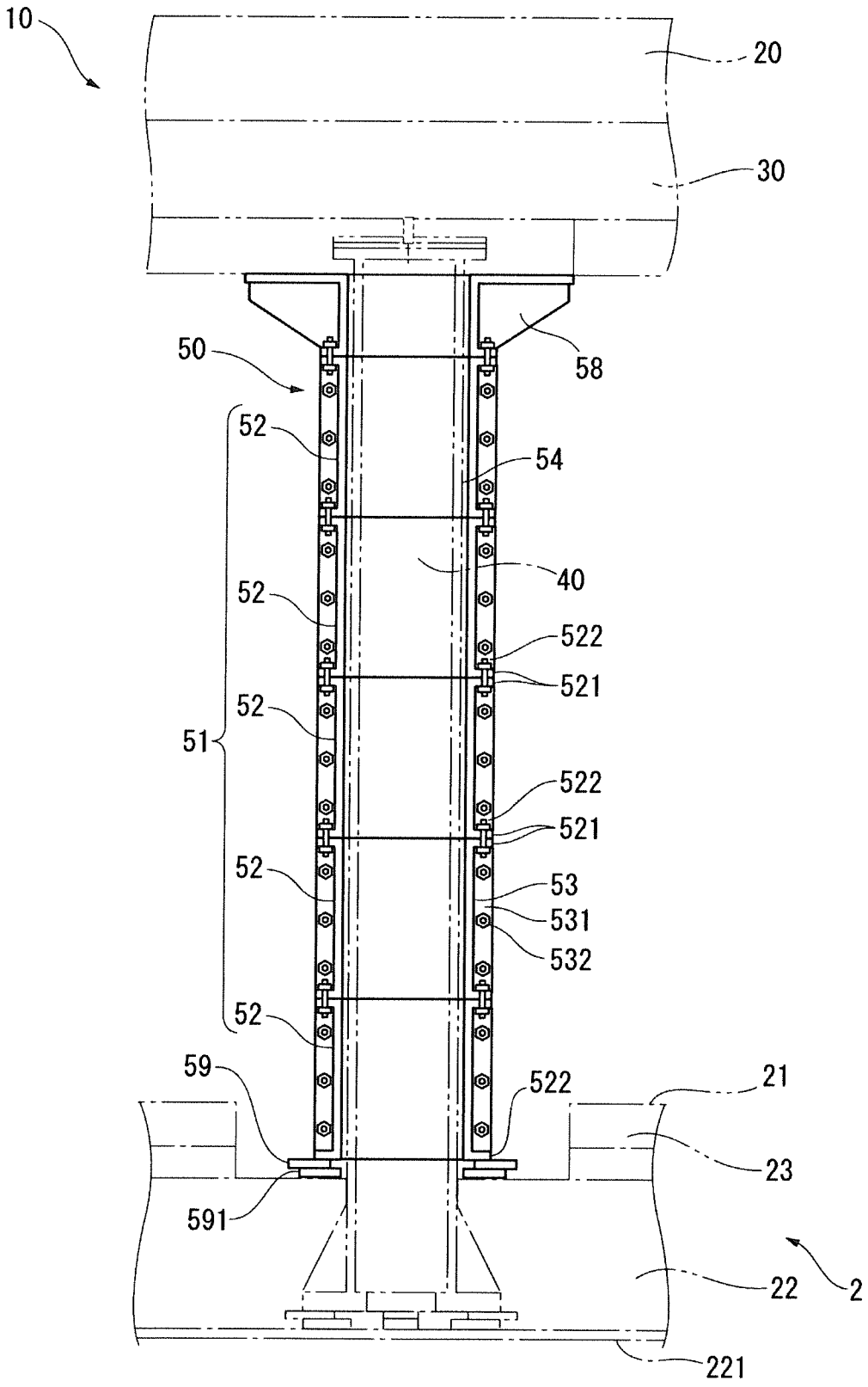

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FIG. 7

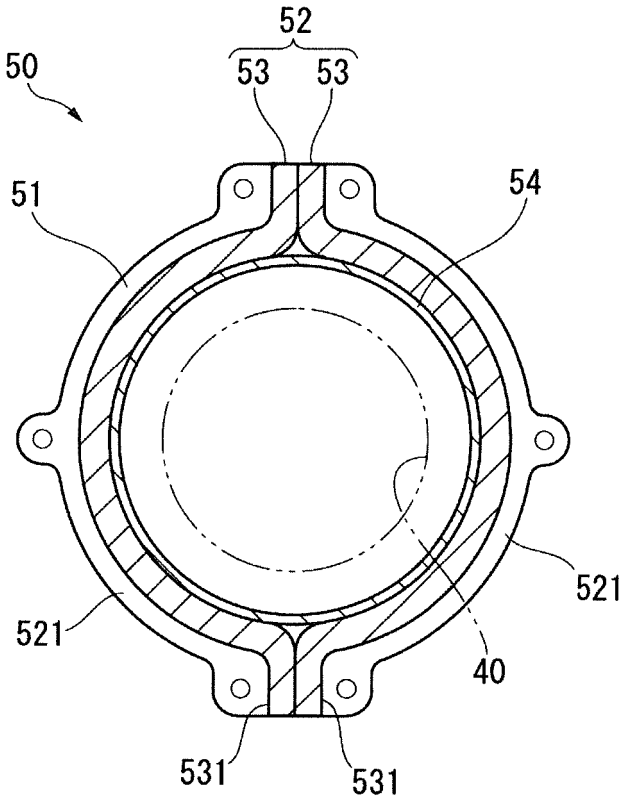


FIG. 8

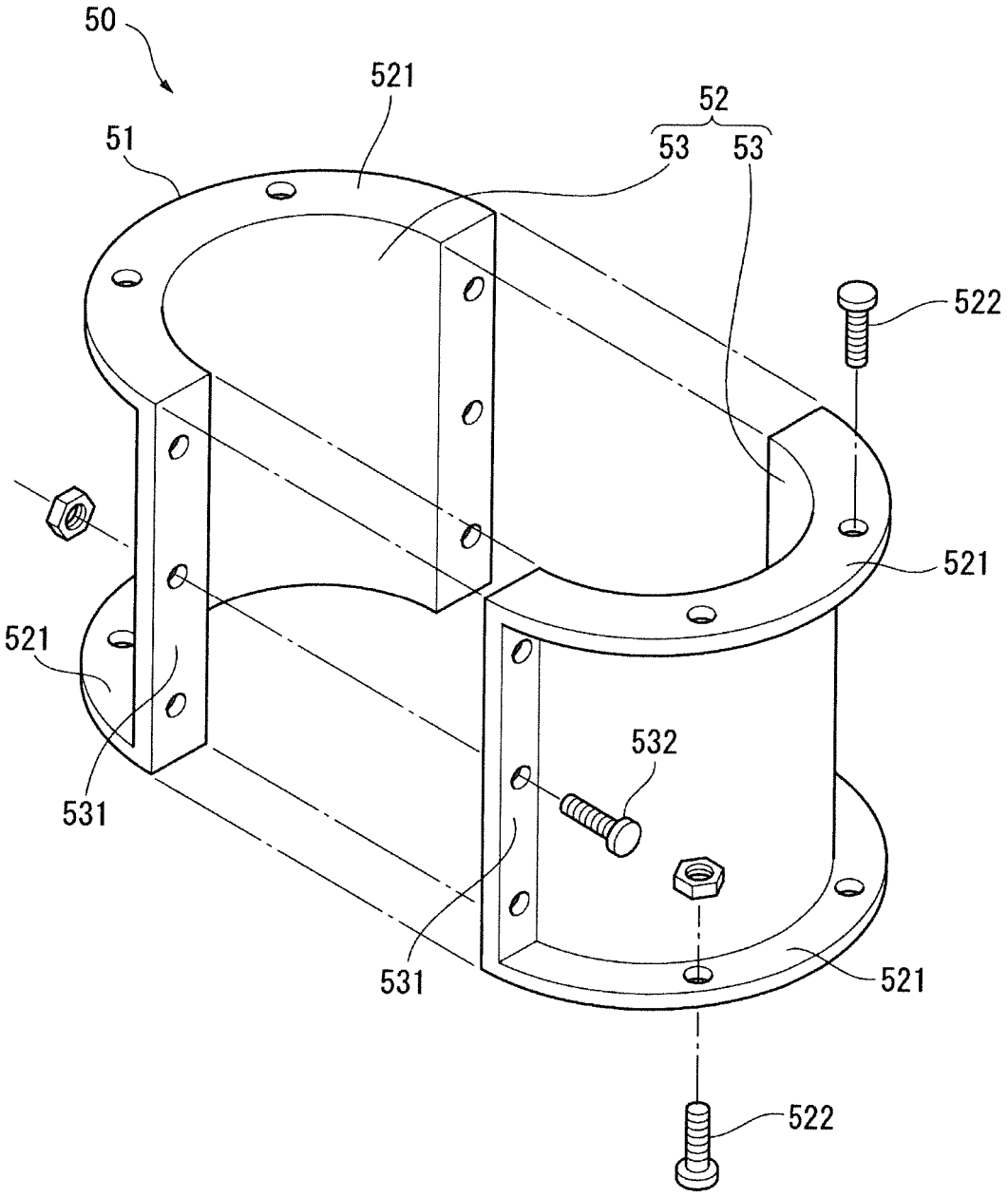


FIG. 9

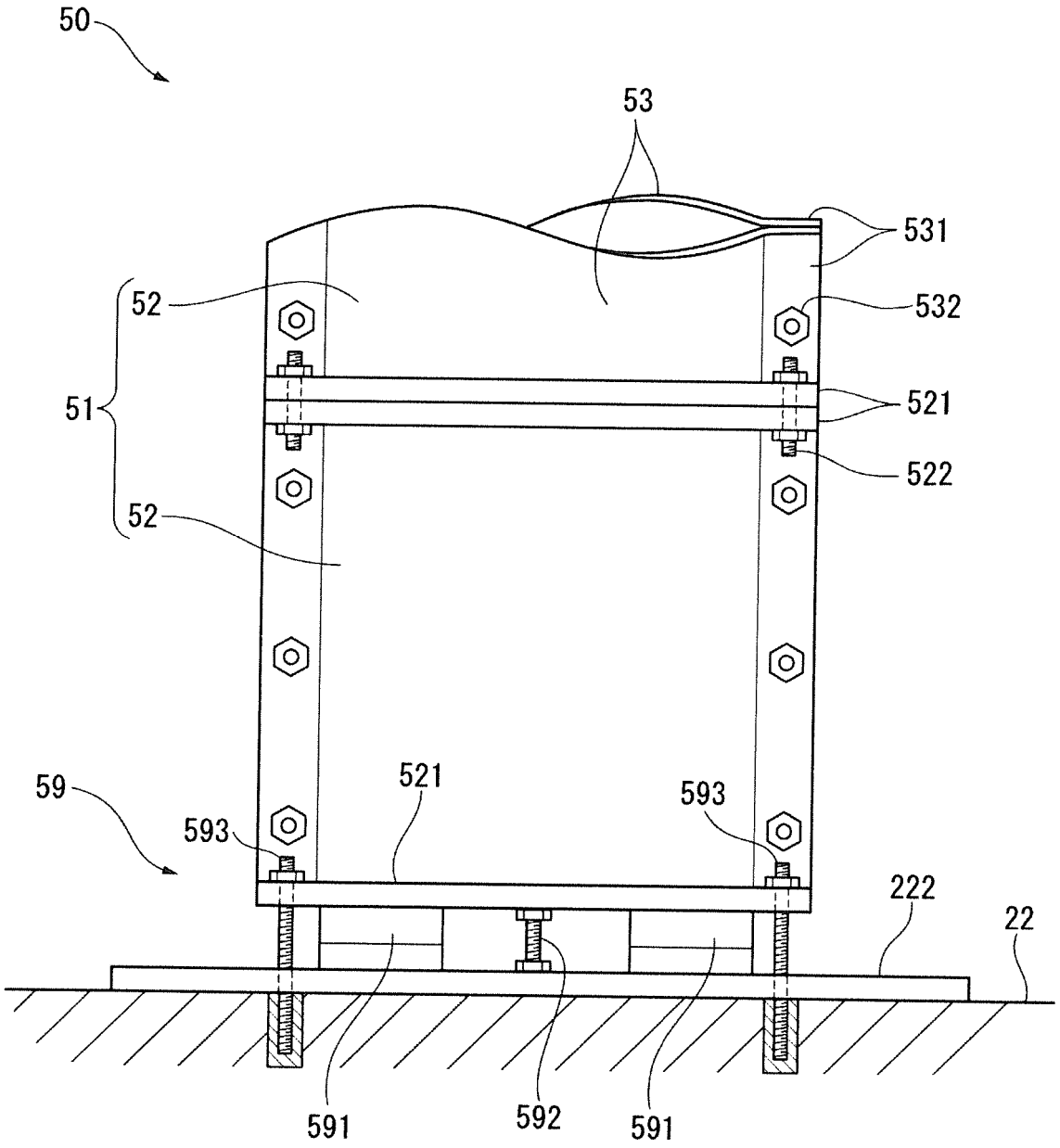


FIG. 10

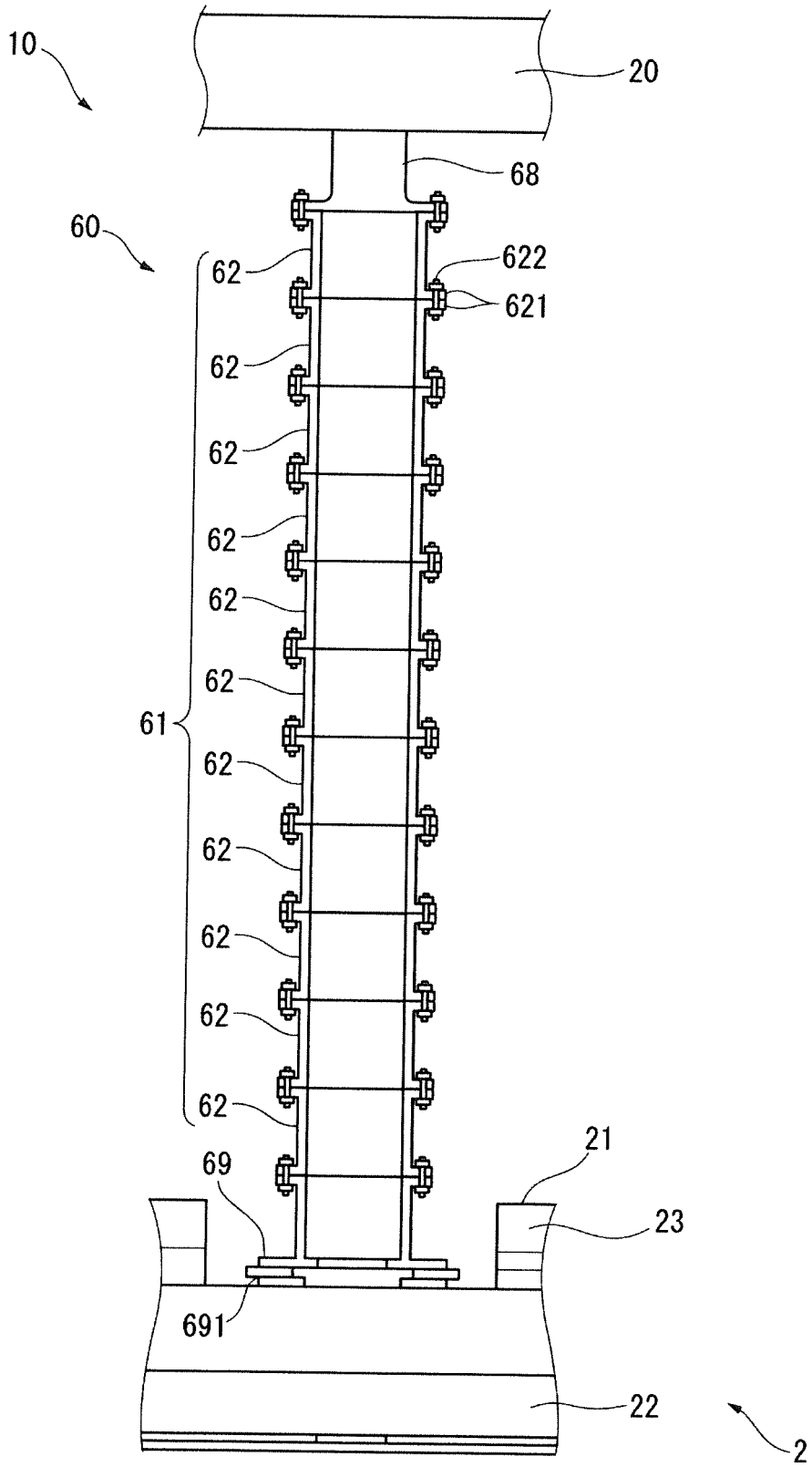


FIG. 11

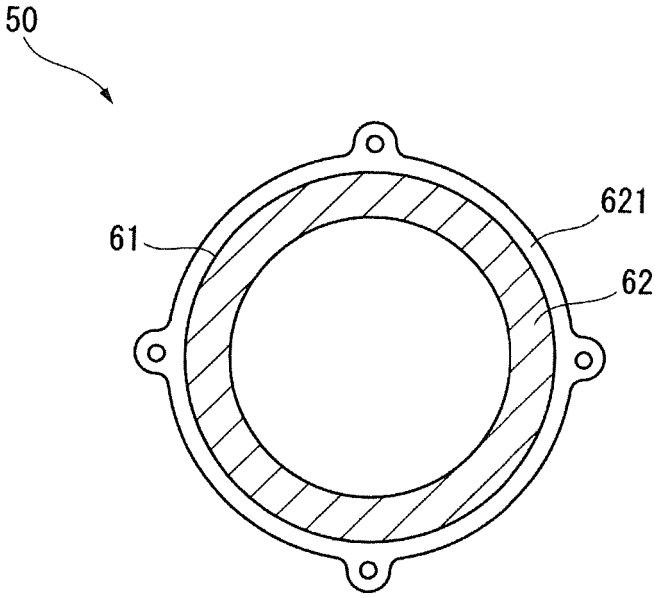


FIG. 12

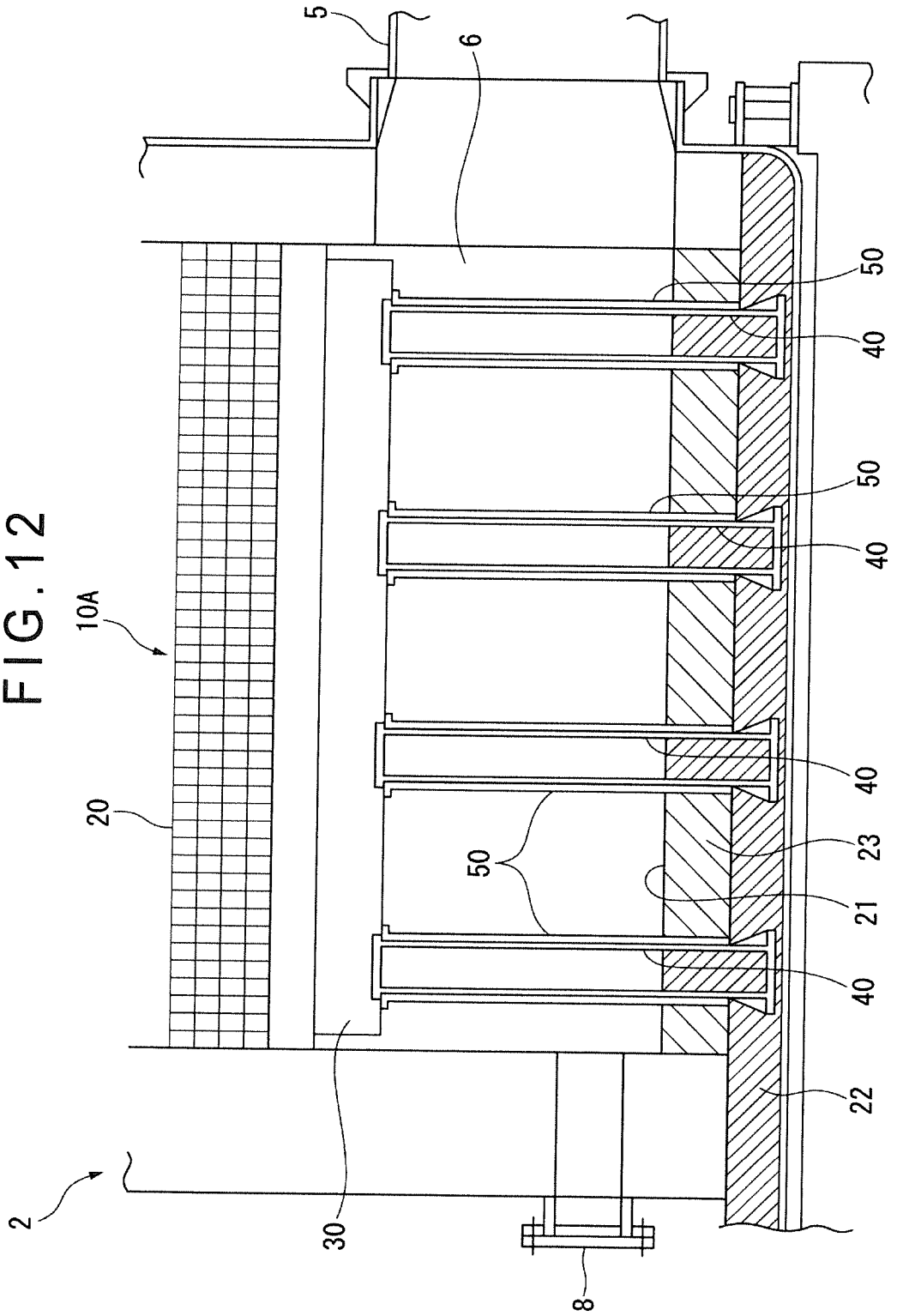
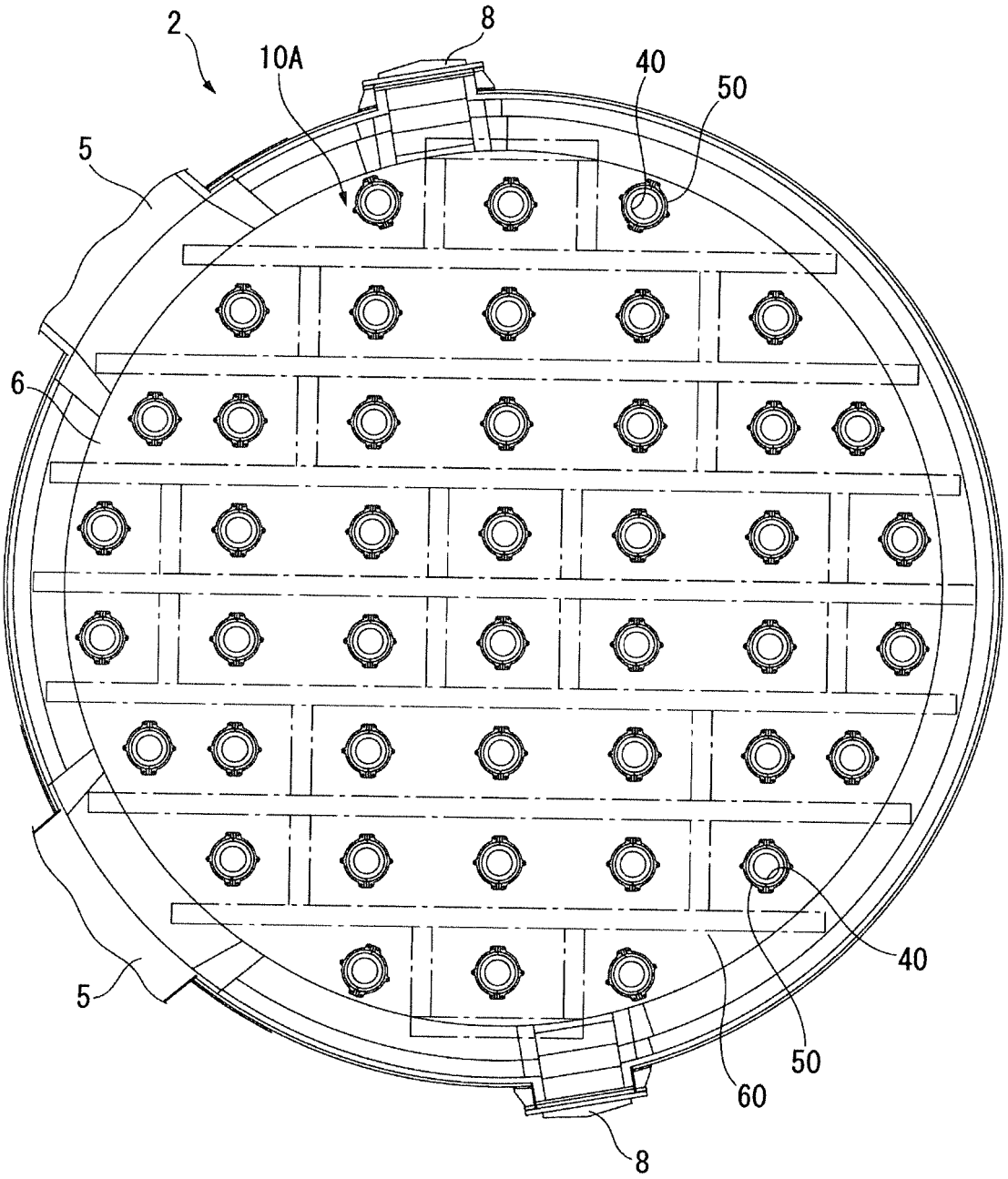


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/010286

A. CLASSIFICATION OF SUBJECT MATTER
C21B9/02(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)
C21B9/02

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 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

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 2016-050464 A (Nippon Steel & Sumikin Engineering Co., Ltd.), 11 April 2016 (11.04.2016), claims; paragraphs [0035] to [0074]; fig. 1 to 9 (Family: none)	1-10
A	JP 51-020004 A (Nippon Steel Corp.), 17 February 1976 (17.02.1976), entire text (Family: none)	1-10
A	US 4235593 A (REPUBLIC STEEL CORP.), 25 November 1980 (25.11.1980), column 5, line 1 to column 7, line 31; fig. 1 to 13 & CA 1131017 A	1-10

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

* Special categories of cited documents:
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"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
09 May 2017 (09.05.17)	23 May 2017 (23.05.17)
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)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 51020004 A **[0009]**