



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
06.04.2011 Bulletin 2011/14

(51) Int Cl.:
C21B 7/00 (2006.01)

(21) Application number: **09803034.9**

(86) International application number:
PCT/JP2009/063625

(22) Date of filing: **24.07.2009**

(87) International publication number:
WO 2010/013793 (04.02.2010 Gazette 2010/05)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

(72) Inventors:
• **FUJITA, Masao**
Tokyo 100-0011 (JP)
• **KUMETA, Takahiro**
Tokyo 100-0011 (JP)

(30) Priority: **31.07.2008 JP 2008197927**
02.06.2009 JP 2009133364

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastraße 4
81925 München (DE)

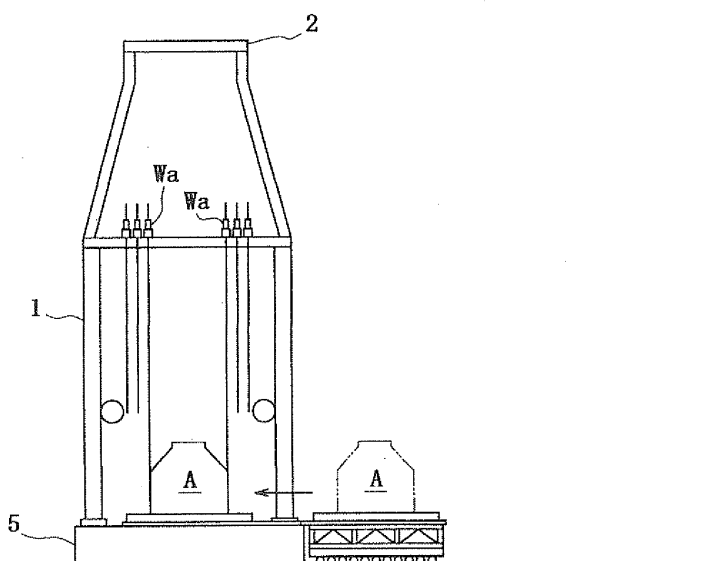
(71) Applicant: **JFE Steel Corporation**
Chiyoda-ku
Tokyo 100-0011 (JP)

(54) **METHOD FOR CONSTRUCTING AND REPAIRING BODY OF BLAST FURNACE**

(57) In the method for constructing and revamping a blast furnace body, in assembling a new furnace body of a blast furnace to construct the blast furnace body or in revamping the blast furnace body by dismantling an old furnace body of an existing blast furnace, and then, stacking ring blocks for the new furnace body to assemble the

blast furnace body, respective connection parts or cut parts of upper and lower ring blocks are temporarily connected by means of a connection tool in advance before the ring blocks are welded and connected or cut, and thereby, the lower ring block is lifted and held on the upper ring block.

FIG. 1



Description

TECHNICAL FIELD

[0001] The present invention relates to a method for constructing a blast furnace body and a method for revamping a blast furnace body in which the blast furnace body is formed into ring blocks. The present invention particularly relates to a method contributing to achievement of new construction and revamping of a blast furnace in a short period.

BACKGROUND ART

[0002] A so-called "block ring construction method" in which a blast furnace body is formed into ring blocks for the purpose of constructing or revamping a blast furnace, as disclosed in Patent References 1 and 2, has recently contributed to achievement of construction and revamping of a blast furnace in a short period.

[0003] In the block ring construction method, used are plural ring blocks into which a furnace body is divided from its furnace top section to its furnace bottom section. In the case of assembling a furnace body in construction of a blast furnace, for example, carried into a caisson in order from the top to the bottom are ring blocks other than a furnace bottom section. On the other hand, the top ring block is first lifted up in the caisson to the height under which an upper ring block to be stacked under the top ring block can be put by means of a winch or the like provided in a scaffold attached to the blast furnace. The upper ring block is carried in next just under the top ring block. The top ring block is then lifted down and superposed on the upper ring block. Following to the above, the plural ring blocks are lifted up together and a subsequent lower ring block is carried in just under the plural blocks to repeat the similar operation. Plural ring blocks are connected in order as described above. A furnace bottom section ring block including a furnace bottom plate is fixed on a base (the caisson) of the blast furnace at last. This is the block ring construction method.

[0004] On the other hand, in the case of dismantling a furnace body in revamping a blast furnace, used is a method in which lifting equipment provided in the attached scaffold (such as a winch, a lift jack, which is a hydraulic lift jack, a wire jack and a center hole jack) is used so that the ring blocks would be cut off in order from a lower ring block and upper ring blocks would be lifted to carry the lower ring block out of the caisson by means of transporting trucks, contrary to the case of the above-mentioned assembling operation.

[0005] There is another method for the case that no equipment necessary to lift up all the ring blocks is provided in the scaffold attached to the blast furnace or the case that no reinforcement means of the scaffold is provided. In such a case, a fulcrum for lifting up a ring block is arranged discretely divided in the scaffold and/or a supporting column so that separately provided lifting

equipment would be used to lift up the respective ring blocks.

[0006] There is a method shown in Figs. 1 to 4, the method carried out in this order, for example, as a typical conventional method for assembling a new furnace body. In the method, a top ring block A manufactured in a factory or the like is first carried into a caisson 5 as shown in Fig. 1 while the top ring block A is lifted up by means of lifting equipment Wa to a gap height under which a subsequent upper ring block B can be put in the caisson 5. The upper ring block B is then carried into the caisson 5 as shown in Fig. 2. The upper ring block B is lifted up by means of lifting equipment Wb.

[0007] Following to the above, plural pieces of lifting equipment Wa and Wb (provided in plural numbers in a circumferential direction; two pieces are shown in the drawings) are used to lift up both of the ring blocks A and B at a stroke to a gap height under which a next ring block C can be put. The lower ring block C is then carried into the formed gap in the caisson 5. The lower ring block C is lifted up by means of another lifting equipment Wc to the height under which a subsequent ring block D can be put, as shown in Fig. 3. The subsequent ring block D, which is the furnace bottom section ring block to be located at the lowest place, is then carried into the caisson 5. The respective ring blocks are stacked in order of D → C → B → A at this stage, as shown in Fig. 4. The respective ring blocks are welded and connected in order after the above. The blast furnace is constructed or revamped in such a conventional method.

[0008] In the conventional construction method in which the respective ring blocks are lifted up by means of the plural pieces of lifting equipment Wa, Wb and Wc as described above, a similar way is adopted not only to an operation of assembling a new furnace body but also to an operation of dismantling an old furnace body. In dismantling an old furnace body, for example, the respective ring blocks A to C are held by means of the respectively different pieces of lifting equipment Wa, Wb and Wc, as shown in Fig. 5. The ring blocks are cut off in order from a lower ring block, the order reverse to the case of assembling a new furnace body, as shown in Figs. 6 and 7. The cut off ring blocks are lifted down by using the lifting equipment and carried out of the caisson 5 by means of transporting trucks.

[0009] Patent Reference 1 discloses another method for shortening time to connect the vertically adjacent ring blocks. Patent Reference 2 proposes a method of revamping and/or constructing a blast furnace for shortening time by dividing a welding operation of the ring blocks into two steps.

[0010] The above-mentioned well-known methods of revamping a blast furnace require around 7 to 10 days as a construction period from dismantlement of an old furnace body to assembly of a new furnace body. Recently, however, required has been a technology of shortening such a period of assembling a new furnace body and dismantling an old furnace body so as to construct

and/or revamp a blast furnace in a shorter period.

Patent Reference 1: JP-B-3165362

Patent Reference 2: JP-B-3157723

Patent Reference 3: JP-B-3111029

[0011] In the conventional ring block method, a furnace shell of an old furnace body is partially cut off when the furnace shell is previously cut into the shape of a ring for the purpose of dismantling the old furnace body into the plural ring blocks, for example. An uncut part (a remaining part) is partially left so that it would be used for lifting a lower ring block. This is considered to be an idea that an upper ring block bears the weight of a ring block located under the cut section. That is to say, the ring block located under the cut section is put on the caisson 5, and then, the uncut furnace shell is cut off and the upper and lower ring blocks having the cut section therebetween are completely separated, thereafter, the separated ring block of the old furnace body is carried out of the caisson 5.

[0012] In the conventional dismantling method in which the uncut part is left, however, it takes at least 2 to 3 hours for cutting off one part in an operation of cutting the uncut part of the furnace shell since the furnace shell is ordinary as thick as 40 mm to 90 mm and the cut length is as long as about 5 m. Moreover, the operation is necessary to be performed whenever a ring block to be taken out is completely separated. Accordingly, it takes around 10 hours so far as the operation is concerned.

[0013] On the other hand, an upper ring block and a lower ring block, which form a new furnace body, are directly welded to each other for connection in assembling the new furnace body under the conventional construction method. That is to say, a top ring block, which is located at a furnace top section, is first carried into the caisson and lifted up. A subsequent upper ring block to be connected with the top ring block, the subsequent upper ring block being located on a lower side of the top ring block, is then carried in to perform centering and alignment of respective furnace shell connecting parts. The respective furnace shell connecting parts are welded after the above so that the top ring block would be connected with the upper ring block. Upper and lower blocks to be connected to each other are completely welded for connection in order every time after they are stacked, as described above. The operation, however, requires long time for welding since the ring blocks (furnace shells) are as thick as 40 to 90 mm and the circumferences of the furnace shells are as long as 35 to 60 m. Further, the operation on an inner surface side of the furnace shells should be carried out under a condition that staves, refractories and such are provided.

[0014] Accordingly, it takes about 10 to 15 hours for carrying out the welding connection step in the conventional construction method. This means that an assembly operation for constructing a new furnace body requires 30 to 50 hours as a whole. Moreover, in the assembly operation, further required is an operation of centering

and aligning upper and lower ring blocks in assembly. In the centering and aligning operation, however, precision should be within 5 mm to secure reliability of welding. It takes at least 3 to 6 hours for centering and aligning the ring blocks having diameters of 12 to 19 m, for example, with such precision. This causes 10 to 20 hours in total to be taken to perform the whole assembling step.

[0015] In the centering and aligning operation, adopted is a method that an upper ring block is lifted down to a location close to a lower ring block and a side surface of the upper ring block is pushed in a radial or circumferential direction by means of a jack or the like to carry out centering and alignment of the upper and lower ring blocks, as disclosed in Patent Reference 3, for example. In the operation, adopted is a method of centering and alignment by pushing a side surface of an upper ring block in a radial or circumferential direction by means of a jack or the like to align the upper and lower ring blocks as shown in Fig. 8. In the method, lifting equipment parts (3a and 3b) are provided at swing fulcrums of the upper ring block.

[0016] Namely, in the case that the upper ring block is pushed in the radial or circumferential direction as shown by an arrow "a" while it is lifted up by means of the jack 3a and 3b, a forward side in swing of the upper ring block is slightly pushed out upward and inclined. In Fig. 8(a), for example, an upper ring block A moves to a position A1 when it is pushed in a radial direction (a) in accordance with the amount of difference in alignment in centering and aligning the upper ring block A and a lower ring block B. At that time, a side moved by the push is raised due to swing in the case that a distance between the lift jacks 3a and 3b is smaller than a diameter of the ring block A. Contrary to the above, a pushed side is raised when the distance between the lift jacks 3a and 3b is larger than the diameter of the ring block A, as shown in Fig. 8(b). Accordingly, it is necessary in such a centering and aligning operation to perform an operation of delicately lifting up or down the upper ring block A in the case that the amount of difference in alignment is large. This requires 10 to 20 hours, 24 hours in some cases, as described above.

[0017] Therefore, the time for cutting and separating ring blocks of an old furnace body in dismantling and for welding and connecting ring blocks of a new furnace body in assembly amounts 50 to 80 hours in total. This means that the time for the operations account for around half of time for the whole steps from dismantling of the old furnace body to assembly of the new furnace body.

DISCLOSURE OF THE INVENTION

[0018] It is an object of the present invention to carry out construction of a new blast furnace and revamping of a blast furnace including operations from dismantling to assembly, in a short period by quickly performing an operation of connecting ring blocks for a new furnace body and operations of cutting and separating ring blocks

for an old furnace body and by simplifying a step from assembly of the new furnace body to dismantling of the old furnace body.

[0019] To achieve the object, the present invention proposes a method of using a connection tool to simply carry out separation of old furnace body or temporary connection of upper and lower ring blocks of new furnace body instead of a method of remaining an uncut part in dismantling of the old furnace body and performing centering, alignment and welding of the ring blocks in assembling of the new furnace body.

[0020] In the case of dismantling of an old furnace body, which is necessary to revamp a blast furnace, for example, when the furnace body is cut into plural ring blocks in a direction of the height thereof, temporarily connected by means of a connection tool in advance are an upper end part and a lower end part of lower and upper ring blocks located each side of dividing line of the ring blocks before complete separation. The temporary connection allows the upper ring block to lift and hold the lower ring block, which is located on the lower side of the cut part. The furnace shell is completely cut off in its circumferential direction after the above to separate the lower ring block from the upper ring block. Each of the separated ring blocks is put in the caisson one by one, and then, the connection tool is cut (separated) before the separated ring block is carried out. This allows many pieces of lifting equipment to be made unnecessary. Further, the respective ring blocks can be separated more quickly than the case of gas-cutting an uncut part of the furnace shell later.

[0021] In the conventional method of dismantling of the old furnace body, cutting of the uncut part of the furnace shell, which has been a critical step, is performed later and the upper and lower ring blocks are completely separated after the cut to carry the respective ring blocks out of the caisson. In the present invention, however, the ring blocks can be carried out quickly only with an operation of cutting (separating) the connection tool instead of a series of the operations. This allows time for the separating operation to be greatly shortened.

[0022] On the other hand, in an operation of assembling a new furnace body, which is performed in constructing a new blast furnace or in revamping a blast furnace, the top ring block located on an upper side is first carried into the caisson to be lifted by means of the lifting equipment. A subsequent upper ring block, which is to be connected with the top ring block, is then carried into the caisson and stacked. Connection parts of the furnace shells of the upper and lower ring blocks are connected at that time. In the case of the present invention, the upper and lower ring blocks are not directly welded and connected to each other in this stage. The upper ring block is first temporarily connected with the lower ring block through the connection tool. The respective ring blocks are then temporarily connected with each other by means of the connection tool and the furnace bottom section ring block is installed in the caisson. The upper ring blocks

are centered and aligned in order after the above. Following to complete centering and alignment of all the ring blocks, the respective connection parts are welded to complete assembly of the furnace body.

[0023] In such an assembly construction method, the respective ring blocks forming a new furnace body can be simultaneously welded to each other in parallel. This contributes to shortening of the operation time.

[0024] Moreover, a step of stacking bricks in the furnace, which has been originally a subsequent step, can be also performed in parallel in the assembly construction method. Simplifying the centering and aligning step and the step of welding of the furnace shells, which have been critical steps in the conventional revamping technology, allows operations in the step of assembling a new furnace body to be reduced by half of the conventional method.

[0025] As clearly described above, summary of the invention is as follows.

[1]. A method for constructing and revamping a blast furnace body, comprising:

assembling a new furnace body of a blast furnace to construct the blast furnace body by taking in and stacking ring blocks for the new furnace body in order from the upper ring block, the ring blocks being formed by dividing the blast furnace body into plural numbers vertically; or revamping the blast furnace body by cutting an old furnace body of an existing blast furnace into plural numbers vertically, taking out and dismantling the cut plural ring blocks in order from the lower ring block, and then, taking in and stacking ring blocks for the new furnace body in order from the upper ring block, the ring blocks being formed by dividing the blast furnace body into plural numbers vertically, to assemble the blast furnace body,

characterized in that:

respective connection parts or cut parts of upper and lower ring blocks are temporarily connected by means of a connection tool in advance before the ring blocks are welded and connected or cut, and thereby, the lower ring block is lifted and held on the upper ring block in at least one of the step of assembling the new furnace body and the step of dismantling of the old furnace body to assembling of the new furnace body.

[2]. The method according to [1], **characterized in that**, in the step of assembling the new furnace body, a lower end part of the ring block to be located on an upper side of the ring block newly carried in and an upper end part of the ring block to be located on a lower side are first temporarily connected by means of the connection tool for temporary connec-

tion, the upper and lower ring blocks are stacked to assemble the furnace body, and then, the upper and lower ring blocks are centered and aligned with respect to each other to perform welding and connection.

[3]. The method according to [1] or [2], **characterized in that**, in the step of dismantling the old furnace body, for the purpose of dismantling the old furnace body, the connection tool is mounted to plural parts along a cutting line between the lower ring block located on a lower side and the upper ring block located on an upper side of the lower ring block during the cut or in advance to the cut so as to temporarily connect the respective blocks, the ring blocks are completely separated along the cutting line with no uncut part left, and then, the connection tool is cut in carrying the ring blocks out to separate the respective ring blocks in order for the carrying out.

[4]. The method according to any one of [1] to [3], **characterized in that** the temporary connection of the upper and lower ring blocks by means of the connection tool in assembly or dismantling is performed by means of a variable connection tool comprising a connection member mounted between a pair of brackets, the connection member being horizontally movable through the pair of brackets, the brackets being provided in plural pairs and fixed along the connection part or the cut parts in a circumferential direction of the furnace.

[5]. The method according to [4], **characterized in that**, the variable connection tool comprises the brackets and the connection member to form a parallel link mechanism.

[6]. The method according to [5], **characterized in that**, a flexible material is used for the connection member.

[7]. The method according to [5], **characterized in that**, the connection member is formed from a rod.

[8]. The method according to [6], **characterized in that**, the flexible material is a wire or a chain.

[9]. A method for constructing and revamping a blast furnace body, comprising:

assembling a new furnace body of a blast furnace to construct the blast furnace body by taking in and stacking ring blocks for the new furnace body in order from the upper ring block, the ring blocks being formed by dividing the blast furnace body into plural numbers vertically, **characterized in that:**

respective connection parts of upper and lower ring blocks are temporarily connected by means of a connection tool in advance before the ring blocks are welded and connected, and thereby, the lower ring block is lifted and held on the upper ring block in the step of assembling the new furnace body.

[10]. The method according to [9], **characterized in that**, in a step of assembling the new furnace body, a lower end part of the ring block to be located on an upper side of the ring block newly carried in and an upper end part of the ring block to be located on a lower side are first temporarily connected by means of the connection tool for temporary connection, the upper and lower ring blocks are stacked to assemble the furnace body, and then, the upper and lower ring blocks are centered and aligned with respect to each other to perform welding and connection.

[11]. A method for constructing and revamping a blast furnace body, comprising:

revamping the blast furnace body by cutting an old furnace body of an existing blast furnace into plural numbers vertically, taking out and dismantling the cut plural ring blocks in order from the lower ring block, and then, taking in and stacking ring blocks for the new furnace body in order from the upper ring block, the ring blocks formed by dividing the blast furnace body into plural numbers vertically, to assemble the blast furnace body,

characterized in that:

respective cut parts or connection parts of upper and lower ring blocks are temporarily connected by means of a connection tool in advance before the ring blocks are cut or welded and connected, and thereby, the lower ring block is lifted up and held on the upper ring block in the step from dismantling the old furnace body to assembling the new furnace body.

[12]. The method according to [11], **characterized in that**, in a step of dismantling the old furnace body, for the purpose of dismantling the old furnace body, the connection tool is mounted to plural parts along a cutting line between the lower ring block located on a lower side and the upper ring block located on an upper side of the lower ring block during the cut or in advance to the cut so as to temporarily connect the respective blocks, the ring blocks are completely separated along the cutting line with no uncut part left, and then, the connection tool is cut in carrying the ring blocks out to separate the respective ring

blocks in order for the carrying out.

ADVANTAGES OF THE INVENTION

[0026] According to the method of construction and revamping of blast furnace body in accordance with the invention, the method having the above structure, expected can be the following advantages.

(1) In the assembling step, adopted is a method of using the connection tool to temporarily connect the ring blocks in carrying in a new furnace body and in welding and connecting the ring blocks. This allows the operation to be simplified, so that a construction period can be shortened, as described below.

[0027] In accordance with the conventional construction method, it is difficult to centering and aligning the ring block of a new furnace body to the ring block located on a lower side thereof due to limitation of the lift jack in assembling the new furnace body. According to the invention, however, adopted is a method of temporarily connecting the ring blocks by means of the connection tool and the variable connection tool capable of movement in a horizontal direction is used for the centering and aligning operation, so that the center in installation of the lifting equipment and such forms no limitation. This allows the precision in installation to be improved. Furthermore, the centering and aligning operation can be performed in parallel to the step of stacking bricks in the furnace after all the ring blocks are taken in. This allows the centering and aligning operation to be excluded from the critical step, and therefore, contributes to shortening of a construction period.

(2) In the dismantling step, the old furnace body can be completely separated in advance. This requires no step of separating an uncut part of the cut part of the old furnace body, the separating step having been essential in dismantling and carrying out the furnace body under the conventional technology. That is to say, in according to the invention, required for the separation is only an operation of cutting a wire, a rod or the like, which is used as the connection tool. This allows the dismantling step to be simplified and the construction period to be shortened.

(3) In accordance with the invention, the advantages allow revamping (from dismantling an old furnace to assembling a furnace shell of a new furnace body) of a large-scaled blast furnace having the inner capacity of 4000 m³ or more to be completed in a short period of only two or three days. It goes without saying that the invention is effective not only for revamping a blast furnace but also for a new technology of constructing a blast furnace.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

Fig. 1 is a simplified view showing a condition of carrying in a furnace top section ring block in assembly in accordance with a conventional construction method.

Fig. 2 is a simplified view showing a condition of carrying in an upper ring block in assembly in accordance with a conventional construction method.

Fig. 3 is a simplified view showing a condition of carrying in a lower ring block in assembly in accordance with a conventional construction method.

Fig. 4 is a simplified view showing a condition of completion of assembly of a blast furnace in accordance with a conventional construction method.

Fig. 5 is a simplified view showing a condition of carrying out a furnace bottom section ring block in dismantling in accordance with a conventional construction method.

Fig. 6 is a simplified view showing a condition of carrying out a lower ring block in dismantling in accordance with a conventional construction method.

Fig. 7 is a simplified view showing a condition of carrying out an upper ring block in dismantling in accordance with a conventional construction method.

Fig. 8 is a simplified view showing a condition of centering and alignment of upper and lower ring blocks in dismantling in accordance with a conventional construction method.

Fig. 9 is a simplified view showing a condition of carrying out a furnace bottom section ring block in dismantling in accordance with a method of the present invention.

Fig. 10 is a sectional view showing a typical structure of a cut part in dismantling an old furnace body.

Fig. 11 is a sectional view of a structure of a cut part in dismantling an old furnace body in accordance with a method of the present invention.

Fig. 12 is a simplified view showing a condition of separation of a furnace bottom section ring block in dismantling an old furnace body in accordance with a method of the present invention.

Fig. 13 is a simplified view showing a condition of carrying out a furnace bottom section ring block in dismantling an old furnace body in accordance with a method of another embodiment of the present invention.

Fig. 14 is a simplified view showing a condition of carrying out a lower ring block in dismantling an old furnace body in accordance with a method of another embodiment of the present invention.

Fig. 15 is a simplified view showing a condition of carrying in a furnace top section ring block in assembling a new furnace body in accordance with a method of the present invention.

Fig. 16 is a simplified view showing a condition of

carrying in an upper ring block in assembling a new furnace body in accordance with a method of the present invention.

Fig. 17 is a simplified view showing a condition of temporarily connecting upper and lower ring blocks by means of a connection tool in assembling a new furnace body in accordance with a method of the present invention.

Fig. 18 is a simplified view showing a condition of carrying in a lower ring block in accordance with a method of another embodiment of the present invention.

Fig. 19 is a simplified view showing a condition of guiding a furnace bottom section ring block to a caisson in assembling a new furnace body in accordance with a method of the present invention.

Fig. 20 is a simplified view showing a first step of assembling a furnace top section ring block by means of a lift jack in assembling a new furnace body in accordance with a method of another embodiment of the present invention.

Fig. 21 is a simplified view showing a condition of carrying in an upper ring block in assembling a new furnace body in accordance with a method of another embodiment of the present invention.

Fig. 22 is a simplified view showing a condition of carrying in a lower ring block in assembling a new furnace body in accordance with a method of another embodiment of the present invention.

Fig. 23 is a simplified view showing a condition of carrying in a furnace bottom section ring block in assembling a new furnace body in accordance with a method of another embodiment of the present invention.

Fig. 24 is a simplified view showing a method of assembling a new blast furnace in accordance with a method of further another embodiment of the present invention.

Fig. 25 is a simplified view showing a method of assembling a new blast furnace in accordance with a method of further another embodiment of the present invention.

Fig. 26 is a simplified view showing different embodiments (a) and (b) of a variable connection tool used in a method of the present invention.

Fig. 27 is a simplified view showing a further another embodiment of a variable connection tool used in a method of the present invention.

DESCRIPTION OF REFERENCE NUMERALS AND SIGNS

[0029]

- 1: SUPPORTING COLUMN
- 2: UPPER ATTACHED SCAFFOLD
- 3, 3a, 3b: LIFT JACK
- 4: FURNACE BODY

4A TO 4D: RING BLOCK

5: CAISSON

6: SLOPE

7, 8: FURNACE SHELL

9: STAVE

10: REFRACTORIES

11, 12: BRACKET

13: CONNECTION TOOL (VARIABLE CONNECTION TOOL)

13a: CONNECTION MEMBER

13b: WIRE CLAMP DEVICE

14: CUT PART

15: TRANSPORTING TRUCK

16: NUT

17: LEVEL ADJUSTING FRAME

18, 19: RAIL

20: TRUCK

21: EDGE PREPARATION PART

EMBODIMENT FOR CARRYING OUT THE INVENTION

[0030] First, described will be a method of revamping a blast furnace in accordance with the present invention on the basis of a ring block construction method adopted with a slope extended to a caisson. A method of constructing a new blast furnace is same as a step of assembling a new furnace body in a below-mentioned method of revamping a blast furnace. The present invention is not limited only to the following concrete examples.

[0031] Fig. 9 illustrates an example of dismantling an old furnace body, showing a condition of separating a lowest furnace bottom section as a furnace bottom section ring block to start dismantling.

[0032] A furnace top section block and a furnace bottom section block may have no ring shape in some cases in dismantling and assembling new and old furnace bodies by means of plural ring blocks in the present invention. For the purpose of description, however, they are collectively referred to as ring blocks in the invention.

[0033] A numeral 1 shown in Fig. 9 denotes a supporting column. 2 denotes an upper attached scaffold. 3 denotes a lift jack used as lifting equipment of ring blocks, the lifting equipment provided in the attached scaffold. 4 denotes a furnace body. 4A to 4D denote divided ring blocks. In Fig. 9, 5 denotes a caisson, which is a caisson of a blast furnace, 6 denotes a slope and 15 denotes a transporting truck.

[0034] Fig. 9 shows a condition that a furnace bottom section ring block 4D, which has been cut and carried out, is carried out to a slope 6. Fig. 10 shows a structure of a cut part in dismantling an old furnace body into blocks. A furnace shell of the old furnace body is to undergo a cutting step from the outside. A numeral 14 in Fig. 10 denotes a cut part of the furnace shell. 7 and 8 denote furnace shells, which are respectively formed into an upper ring block and a lower ring block after a cut, in Fig. 10. 9 denotes a stave. 10 denotes refractories. In

the example shown in Fig. 10, a position of the cut is located in a place where the refractories 10 are embedded between the staves 9. It is, however, not limited only to the above and may be located in a place where the stave 9 is embedded. In other words, wherever the cut is made, a part other than the furnace shell can be separated since it is the stave 9 and a cooling water supplying pipe vertically extending on upper and lower sides of the stave 9, lining refractories, or deposit in the furnace so long as a furnace shell part can be cut and separated.

[0035] Most of the furnace shell of an old furnace body has been cut in a circumferential direction in advance so that a part of the furnace shell would have remained uncut in cutting the furnace shell to form ring blocks, conventionally. The uncut part of the furnace shell has been cut off while the ring block has been put on a transporting truck 15 in the caisson 5, so that the ring block has been completely separated. The cut of the furnace shell is an operation for dividing the old furnace body into a size of easy carrying out. Fig. 9 shows an example that the old furnace body is divided into four ring blocks 4A to 4D for the purpose of dismantling. For the dismantling, preferable is division into three to five ring blocks in accordance with a size of the furnace body and the like.

[0036] Fig. 11 shows a structure of a cut part in dismantling an old furnace body in accordance with the method of the present invention. Fig. 11 shows a condition that upper and lower ring blocks are temporarily connected via a connection tool 13. Plural pairs of brackets 11 and 12 are welded and fixed to the furnace shell 7, which is formed into the upper ring block, and the furnace shell 8, which is formed into the lower ring block, in advance in the vicinity of an upper end part and a lower end part of the furnace shells 7 and 8 along a cut part and a connected part of the furnace shells, as shown in Fig. 11. A connection member 13a formed from a wire, a rod, a chain or the like is mounted between the both brackets 11 and 12 to form the connection tool 13. In a preferable mode of the connection tool 13, the connection member 13a is formed from a flexible material such as a wire chain, for example, and a variable connection tool enabling at least one of the upper and lower ring blocks to be movable in the horizontal direction is used. Such a connection tool 13 (the "connection tool 13" includes a variable connection tool, hereinafter.) is mounted later and used for temporarily connecting the upper and lower ring blocks with each other.

[0037] The temporary connection by means of the connection tool 13 can be carried out simultaneously with a cutting operation. That is to say, in cutting the furnace shells 7 and 8 into the ring blocks, namely, before completing the cutting operation or during the cutting operation, for example, most of the furnace shell is cut in advance and the connection tool is mounted to the cut part simultaneously with the cutting operation.

[0038] As a result, the lower ring block is lifted up and held of the upper ring block through the connection tool 13, especially, the connection member 13a, after the up-

per ring block and the lower ring block are separated.

[0039] In this respect, the furnace shell has been remained uncut (an uncut part) as long as the length necessary for holding a subsequent lower ring block in the conventional step of cutting the ring blocks. For the purpose of carrying out a ring block, all ring blocks have been lifted down by means of a lift jack to be put on the transporting truck 15 in the caisson 5. The lower ring block, which should be carried out, has not been completely separated until the uncut part of the upper ring block has been cut.

[0040] On the other hand, the respective ring blocks 4A, 4B and 4C are temporarily connected by means of the connection tool 13 in advance during or before the cutting operation when the ring blocks 4A, 4B and 4C are separated, as shown in Fig. 12, in the present invention. In the case that the ring block 4C is cut and separated to be carried out, for example, the ring blocks 4A, 4B and 4C, which have been temporarily connected by means of the connection tool 13, are lifted down by means of the lift jack 3 provided in the lower attached scaffold 1 to put the ring block 4C on the transporting truck 15 in the caisson 5. The connection tool 13 connecting the ring blocks 4B and 4C is then cut off, and thus, the ring block 4B and ring block 4C are completely separated at that time. The ring block 4C is put on the transporting truck 15 to be carried out of the caisson 5 through the slope 6 after the above.

[0041] As described above, respective cut parts 14 of the respective ring blocks 4A to 4C are temporarily connected by means of the connection tool 13 so as to lift up and hold the ring blocks in dismantling a furnace body in the present invention. As shown in Fig. 11, the connection tool 13 is formed from the connection member 13a such as a wire and a rod (a rod is fasten by means of a nut 16 in Fig. 11.), which is mounted between the brackets 11 and 12 fixed by welding to outer surfaces of the furnace shells 7 and 8 located on upper and lower sides of a cutting line, a pair of the upper and lower brackets 11 and 12 being mounted in plural umbers in the circumferential direction. In this case, the respective cut parts of the ring blocks 4A to 4C are completely separated with no conventional uncut part left. This allows no operation of cutting (separating) an uncut part of a furnace shell to be required in carrying out a ring block, so that only an operation of separating the connection member 13a is necessary. Accordingly, left is only a simple operation in accordance with the method of the present invention.

[0042] Now, described will be how to carry out the ring block 4B. Both of the ring blocks 4A and 4B are first lifted down by means of the lift jack 3 to put the ring block 4B on the transporting truck 15 in the caisson 5. The connection member 13a is then cut off so as to separate the ring block 4B from the ring block 4A. Therefore, in accordance with the construction method according to the present invention required for an operation of separating the respective ring blocks is only a weld-cutting operation

of several connection members 13a by means of a gas torch, the connection members 13a being mounted along a cutting line in a circumferential direction of the furnace. This allows operation time to be greatly shortened in comparison with the conventional cutting operation of an uncut part.

[0043] In Fig. 11, the brackets 11 and 12 and the connection member 13a, which form the connection tool 13, are used for temporarily connecting the upper and lower ring blocks (shown as the furnace shells 7 and 8) with each other. They are cut off in carrying out the ring block in order to separate the respective ring blocks. The number and strength of the connection tool 13 is not fixed so long as the connection tool 13 can lift down and hold the subsequent lower ring block. The connection member of the example shown in Fig. 11, for example, is formed from a combination of the connection member 13a and the nut 16. In the case that a wire clamp device (JP-B-H6-71999, JP-A-2006-125563 and such) is used, however, only required is a wire stretched between the brackets 11 and 12 as the connection member 13a, as shown in Fig. 17. This allows connection to be simplified and the cutting operation to be easily and quickly performed. In the description, exemplified is a cutting operation of the connection tool 13 in separating the respective ring blocks. Detaching the nut 16, however, can also achieve the separation. Any one of cutting and detaching can be selected in accordance with contents of construction.

[0044] Now, described as another embodiment of the invention on the basis of an example of dismantling an old furnace body will be a construction method in which each ring block is individually lifted up by means of a lift jack (such as a so-called "center hole jack" using several wires to equally carry out raising and lowering), the lift jack being provided separately in the attached scaffold and/or the supporting column.

[0045] The embodiment is an example of dismantling by dividing a furnace body 4 into the ring blocks 4A to 4D as shown in Fig. 13. The example is different from that of Fig. 9 in that the ring blocks 4A, 4B and 4C are lifted separately by means of a lift jack 3a for lifting up the ring blocks 4A and 4B and a lift jack 3b for lifting up the ring block 4C. Other points such as cutting, separation, carrying out and the like in dismantling an old furnace body, however, are the same as the example shown in Fig. 9. Further concrete description will be given below.

[0046] The embodiment is characterized in that the ring blocks 4A and 4B and the ring block 4C are lifted respectively by means of the different lift jacks 3a and 3b in carrying out the lower ring block 4C subsequently to the furnace bottom section ring block 4D while the ring blocks 4A and 4B are temporarily connected by means of the connection tool 13, as shown in Fig. 14. That is to say, the ring block 4C is separated as it is to be lifted down as shown in Fig. 14 since it is held by means of the lift jack 3b differently from the ring blocks 4A and 4B. The lifted-down ring block 4C is put on the transporting truck 15 in the caisson 5 to be carried out.

[0047] In order to separate the upper ring blocks 4A and 4B, most part of the furnace shell of the old furnace body is first cut in advance before or during the cutting operation of the furnace shell or when the furnace shell is cut into the shape of a ring. The connection tool 13 is then mounted to a part, which has been cut off, to temporarily connect the both ring blocks 4A and 4B. The ring blocks 4A and 4B having been temporarily connected by means of the connection tool 13 are lifted down by means of the lift jack 3a after the above. The connection member 13a of the connection tool 13, which connects the ring blocks 4A and 4B, is then cut off, so that the ring blocks 4A and 4B are completely separated at that time. This allows the ring block 4B to be carried out. The ring block 4A is finally lifted down as it is to be carried out. The old furnace body is thus completely dismantled.

[0048] Now, described will be an embodiment of assembly of a new furnace body in accordance with the method of the present invention on the basis of an example shown in Figs. 15 to 19. The embodiment is a method also applied as it is for construction of a new blast furnace. In the operation of assembling a new furnace body, the furnace top section ring block 4A, which is located at the top of the furnace body, is first carried into the caisson 5 through the slope 6 while it is put on the transportation truck 15, as shown in Fig. 15. The furnace top section ring block 4A is then lifted up by means of a lift wire of the lift jack 3a. Following to the above, the upper ring block 4B, which is to be located under the furnace top section ring block 4A located at the top of the furnace, is carried into the caisson 5 by means of the transporting truck 15 so as to be provided in a space created by lifting up the ring block 4A, as shown in Fig. 16. A lower end part of the ring block 4A is temporarily connected with an upper end part of the ring block 4B by means of the connection tool 13.

[0049] Fig. 17 shows an example of the temporary connection of the furnace top section ring block 4A and the upper ring block 4B. In the case of the temporary connection shown in Fig. 17, the brackets 11 and 12 are first welded and fixed in advance to a lower end part of the furnace shell 7 of the furnace top section ring block 4A and an upper end part of the furnace shell 8 of the upper ring block 4B. Between the brackets 11 and 12, provided is the above-mentioned connection member 13a such as a wire and a rod, a wire of the wire clamp device 13b in the example shown in Fig. 17. The brackets 11 and 12 are thus connected to form the connection tool 13, which is used in the example.

[0050] Around 10 to 70 connection tools 13 are provided in a circumferential direction of the furnace. Basically, used are the connection tools similar to the above-mentioned connection tools used in the dismantlement. Using a variable connection tool having a structure that any one or both of the furnace top section ring block 4A and the upper ring block 4B is movable in a horizontal direction in a condition of temporary connection of the ring blocks 4A and 4B, however, is effective since center-

ing in the caisson 5 is necessary in assembling a new furnace body.

[0051] As such a variable connection tool 13, for example, preferable is one formed from a flexible material between the brackets 11 and 12, the flexible material enabling at least one of the ring blocks to move in the horizontal direction even in the condition of the temporary connection, or a connecting means allowing the horizontal movement of the ring block, A wire, a chain and such, which can bear a heavy load, are preferable as the former material while a rod is preferably used as the latter means.

[0052] Further, the variable connection tool 13 preferably has a structure of a bearing seat provided on brackets 11 and 12 sides, the bearing seat capable of corresponding to an incline of the rod in an operation of the horizontal movement, or a structure of a bracket provided with an opening having a diameter capable of permitting an incline of the rod. The upper and lower brackets 11 and 12, which are formed into a pair and provided in plural pairs, are preferably provided substantially horizontally. The connection tool 13 used in a step of dismantling an old furnace body is only for lifting and holding the lower ring block. Accordingly, no such a variable connection tool as described above is required since there is no necessity of centering and alignment and the connection tool 13 is to be cut later. The variable connection tool, however, may be used in the dismantling step.

[0053] It is preferable to provide an edge preparation part 21 for welding connection in a gap between the furnace shells 7 and 8 of the upper and lower ring blocks, which are to be connected, in assembling a new furnace body.

[0054] After the above, carried into and put on the caisson 5 are the lower ring blocks 4C and 4D, as shown in Figs. 18 and 19. The ring blocks 4C and 4B are temporarily connected by means of the variable connection tool 13, for example, in a way similar to the method shown in Fig. 15 so as to perform lifting and holding.

[0055] In the above description, a new furnace body is divided into four as an example. The division is made into three, five, six or more in some cases in accordance with a size of the blast furnace. The method of connection can be similar to the above even in such a case.

[0056] The furnace bottom section ring block 4D, which is to be located in the lowest position, is then carried in according to a step similar to the above. The furnace bottom section ring block 4D is temporarily connected by means of the variable connection tool 13 in the same way. All of the ring blocks 4A, 4B, 4C and 4D are collectively lifted up while the transportation truck 15 is sided away so that the ring blocks would be fixed on the caisson 5. The lowest furnace bottom section ring block 4D is first centered, and then, the ring blocks 4C, 4B and 4A are centered and stacked in order from the upper ring block.

[0057] In the invention, considered may be a method in which the ring blocks 4C to 4A are once collectively lifted up to carry in the lowest furnace bottom section ring

block 4D, centering is performed for the purpose of specifying a construction location of the lowest furnace bottom section ring block 4D, the lowest furnace bottom section ring block 4D is fixed, and then, the ring blocks 4A, 4B and 4C, which have been lifted up, are centered and stacked in order of the upper ring block 4C, the ring block 4B and the ring block 4A.

[0058] The furnace bottom section ring block 4D is extremely heavy especially in the case of building a brick construction (including monolithic refractories) in the lowest furnace bottom section ring block 4D in advance. This causes a possibility of a crack and the like of the brick construction due to a bend of the ring block in lifting up the ring block. In this case, the lowest furnace bottom section ring block 4D, which has been carried in, is first moved and centered for positioning without lifting up the ring block 4D, and then, completely fixed on the caisson 5. Following to the above, the ring blocks 4A, 4B and 4C having been lifted up as described above are centered and aligned with respect to the fixed lowest furnace bottom section ring block 4D to be stacked in order from the upper ring block 4C.

[0059] In the centering and aligning operation, a side surface of the upper furnace body block is pushed in a horizontal direction or a circumferential direction of the furnace by means of the plural lift jacks 3a to perform centering and alignment with the furnace body. The centering is carried out in order from the ring block 4D, for example. In the case of difference in centering (difference over 5 mm in location of the ring block having the diameter of 12 to 19 m, for example), a side surface of the upper ring block 4C is pushed in the horizontal direction or the circumferential direction of the furnace by means of the lift jack 3a to be centered and aligned with the lower ring block 4D for the purpose of positioning. Using the variable connection tool 13 at that time allows the operation to be simply and quickly performed since the upper ring blocks 4B and 4C are movable in the horizontal direction. The centering and aligning operation is similarly carried out between the ring blocks 4B and 4C and between the ring blocks 4A and 4B.

[0060] The ring blocks 4A to 4D, which have been centered and aligned as described above and have been stacked, are welded and connected completely after the above. That is to say, after the steps of carrying in, temporarily connecting, centering and aligning and stacking the respective ring blocks 4A to 4D, which are to be formed into a new furnace body, welded and connected is the edge preparation part 21 provided in the gap, which is to be a connection part of the adjacent ring blocks. Assembly of the furnace body is thus completed. The connection tool 13 is weld-cut to be removed at the completion or after the above operation.

[0061] Further another embodiment of the present invention is a method constructing and revamping a blast furnace in which the ring blocks are respectively lifted up by means of the lift jacks having different roles, the lift jacks separately provided so that a location of lifting up

the ring block would be in an attached scaffold 2 of the blast furnace and/or the supporting column 1.

[0062] An example of the embodiment will be described on the basis of Figs. 20 to 24. Fig. 20 shows a condition that the furnace top section ring block 4A provided at the top is carried in and taken in. The subsequent upper ring block 4B is carried in after the furnace top section ring block 4A is carried in, as shown in Fig. 21. In the embodiment, the furnace top section ring block 4A and the upper ring block 4B are temporarily connected via the connection tool 13 to be lifted up and held together by means of the lift jack 3a. The furnace top section ring block 4A and the upper ring block 4B, which have been held by means of the lift jack 3a, are lifted up while the subsequent further lower ring block 4C is carried into a space under the ring blocks 4A and 4B, as shown in Fig. 22. The lower ring block 4C is held by means of the lift jack 3b different from the lift jack 3a.

[0063] The lower ring block 4C is lifted up by means of the different lift jack 3b, as shown in Fig. 23. In a space under the ring block 4C, carried in is the lowest furnace bottom section ring block 4D. The lower ring block 4C and the furnace bottom section ring block 4D are temporarily connected and lifted and held via the variable connection tool 13, preferably. The lower ring block 4C and the furnace bottom section ring block 4D are movable in the horizontal direction since they are lifted and held through the variable connection tool 13. This allows the furnace bottom section ring block 4D to be simply and quickly fixed in the caisson 5 and centered. Moreover, both of the lower ring blocks 4C and 4B move easily in the horizontal direction in centering and aligning the lower ring blocks 4C and 4B in the case that the ring block 4B is lifted up and held on the furnace top section ring block 4A through the variable connection tool 13. This results in simple centering and alignment of the upper ring block and the lower ring block.

[0064] The furnace bottom section ring block 4D is put on a level adjusting frame 17, which can be adjusted to the level same as that of the caisson 5, and carried, as shown in Fig. 24, in the case of using the transporting truck 15 without the slope 6 shown in Fig. 23. The furnace bottom section ring block 4D is put on a truck 20, which runs on a running rail 18. The lower ring block 4C is lifted up by means of the lift jack 3b. The lowest furnace bottom section ring block 4D is moved on the rail 19 to be carried into a space under the lifted lower ring block 4C. It is also possible to temporarily connect and lift the lower ring block 4C and the furnace bottom section ring block 4D through the variable connection tool 13.

[0065] In the present invention, a new blast furnace can be constructed in accordance with further another embodiment described below.

[0066] Fig. 25 shows an example of ring blocks divided into three of 4A, 4B and 4C. The ring block 4A and 4B are temporarily connected by means of the variable connection tool 13. The lowest furnace bottom section ring block 4C is transported through the general level adjust-

ing frame 17 in the case that the height of the transporting truck 15 (also referred to as a unit dolly) is different from the height of the caisson in which the furnace body is fixed. The furnace bottom section ring block 4C can be moved from the position of the transporting truck through the rail 18 provided on the frame to the rail 19 provided on the caisson 5 to be put in the caisson 5, as shown in Fig. 25. The rail 19 may be buried as it is or removed after the furnace bottom section ring block 4C is fixed. Further, used can be an air caster capable of moving a heavy material and fine adjustment of a location for installation instead of the rail.

[0067] The upper ring block 4B can be centered, aligned and fixed to the lowest furnace bottom section ring block 4C in a way of parallel movement such that the ring block 4B is pushed left and right, similarly to the above description. In the structure that the ring blocks are divided into three, the ring block 4B capable of parallel movement is located above the furnace bottom section ring block 4C, which is fixed only by movement. This means quick and easy centering and alignment. The ring block 4A is put on the ring block 4B after the ring block 4B is centered and aligned to be fixed. The ring blocks 4A and 4B and the ring blocks 4B and 4C are respectively welded and connected to each other to complete assembly of the furnace body following to the above. The ring blocks 4A and 4B are temporarily connected by means of the variable connection tool 13. The lift jack 3c for the ring block 4B, which is shown by a dotted line in Fig. 25, however, can be used for the purpose of securing safety. In centering, carrying a lifting load mainly by the variable connection tool 13 allows adjustment of the centering by parallel movement to be achieved.

[0068] In the structure of the ring blocks divided into four, an operation of welding and connecting the furnace shells 7 and 8 and an operation of centering the respective ring blocks 4A to 4C located on the upper side of the furnace bottom section ring block 4D can be performed in parallel with an operation of stacking bricks at the furnace bottom in the furnace bottom section ring block 4D although it has conventionally taken long time for the former operations. As a result, in accordance with the invention, the operations of centering and stacking the ring blocks located on the upper side of the lower ring block 4C and the operations of welding and connecting the respective ring blocks 4C and 4D can be performed within 20 to 30 days, which have been conventionally needed for an operation of stacking the bricks at the furnace bottom in the furnace bottom section ring block 4D. This gives time to a construction period.

[0069] Furthermore, the ring block 4B can be centered and fixed onto the furnace bottom section ring block 4C just after the furnace bottom section ring block 4C is centered and fixed in the example of the ring blocks divided into three of 4A, 4B and 4C.

[0070] Fig. 26(a) shows an example of the variable connection tool 13, which has a parallel link structure formed from a combination of a pair of the brackets 11

and 12 and the connection member (rod) 13a. Fig. 26(b) shows an example of a wire clamp device 13b using a wire as the connection member 13a. Fig. 26 also shows an example of temporary connection by means of the wire clamp device in which a wire is clamped to hold the wire on the brackets 11 and 12 and a wire unit is hydraulically fixed.

[0071] Such a connection of the respective ring blocks 4A and 4B by means of the various kinds of connection tool 13 including a variable connection tool is just a temporary connection (joint) only for carrying a load of the upper ring block 4B under the connected part. This requires no centering operation. Accordingly, the operations can be completed within one hour. From this point of view, the construction period can be greatly shortened, compared with the conventional case that it takes 10 to 20 hours for connection of blocks of a new furnace body.

[0072] In revamping a blast furnace, tens of welding operators has been conventionally provided around the furnace shell to perform operations night and day continuously. In accordance with the present invention, however, such an operation is no longer required and only a normal operation should be carried out. This causes quality in operation to be improved. Moreover, in order to center the furnace body, centering and aligning the furnace bottom section ring block 4D with the center of the caisson 5 allows centering and alignment of the subsequent ring blocks with the center of the above in order to be only required after the above. Accordingly, conventional influence of a center of a jack lifting up a furnace body can be removed, so that precision in installation can be improved.

[0073] In the above, described has been the ring block construction method in which the slope 6 is provided at the same level as the caisson 5. In the case that it is difficult to provide a slope since the level of the caisson 5 is high, however, another method may be adopted. That is to say, the level adjusting frame 17 is provided on the transporting truck 15 to lay the rail 18 thereon, the rail 19 in the furnace, which is to be located at the level same as that of the rail 18, is provided also on the caisson 5, the truck 20 is put on the rails 18 and 19, and the respective furnace body ring blocks 4A to 4D are put on the truck 20 to carry in or out the ring blocks of the new or old furnace body as shown in Fig. 24. Performing the operations from connecting to dismantling the ring blocks of the old furnace body and the operation of carrying in and connecting the ring blocks of the new furnace body as described above allow revamping and constructing steps of a blast furnace, which include operations of carrying out and in the ring blocks of the new and old furnace bodies, to be greatly shortened in view of a construction period more than the conventional case.

Industrial Applicability

[0074] The method of revamping and constructing a blast furnace in accordance with the present invention is

applicable not only in the case of the above-mentioned ring block construction method but also as a revamping and constructing technology having the basically similar structure in another technical field.

Claims

1. A method for constructing and revamping a blast furnace body, comprising:

assembling a new furnace body of a blast furnace to construct the blast furnace body by taking in and stacking ring blocks for the new furnace body in order from the upper ring block, the ring blocks being formed by dividing the blast furnace body into plural numbers vertically; or revamping the blast furnace body by cutting an old furnace body of an existing blast furnace into plural numbers vertically, taking out and dismantling the cut plural ring blocks in order from the lower ring block, and then, taking in and stacking ring blocks for the new furnace body in order from the upper ring block, the ring blocks being formed by dividing the blast furnace body into plural numbers vertically, to assemble the blast furnace body,

characterized in that:

respective connection parts or cut parts of upper and lower ring blocks are temporarily connected by means of a connection tool in advance before the ring blocks are welded and connected or cut, and thereby, the lower ring block is lifted and held on the upper ring block in at least one step of the step of assembling the new furnace body and the step of from dismantling of the old furnace body to assembling of the new furnace body.

2. The method according to Claim 1, **characterized in that**, in the step of assembling the new furnace body, a lower end part of the ring block to be located on an upper side of the ring block newly carried in and an upper end part of the ring block to be located on a lower side are first temporarily connected by means of the connection tool for temporary connection, the upper and lower ring blocks are stacked to assemble the furnace body, and then, the upper and lower ring blocks are centered and aligned with respect to each other to perform welding and connection.
3. The method according to Claim 1 or 2, **characterized in that**, in the step of dismantling the old furnace body, for the purpose of dismantling the old furnace body, the connection tool is mounted to plural parts

along a cutting line between the lower ring block located on a lower side and the upper ring block located on an upper side of the lower ring block during the cut or in advance to the cut so as to temporarily connect the respective blocks, the ring blocks are completely separated along the cutting line with no uncut part left, and then, the connection tool is cut in carrying the ring blocks out to separate the respective ring blocks in order for the carrying out.

4. The method according to any one of Claims 1 to 3, **characterized in that** the temporary connection of the upper and lower ring blocks by means of the connection tool in assembly or dismantling is performed by means of a variable connection tool comprising a connection member mounted between a pair of brackets, the connection member being horizontally movable through the pair of brackets, the brackets being provided in plural pairs and fixed along the connection part or the cut parts in a circumferential direction of the furnace. 5
5. The method according to Claim 4, **characterized in that** the variable connection tool comprises the brackets and the connection member to form a parallel link mechanism. 15
6. The method according to Claim 5, **characterized in that** a flexible material is used for the connection member. 20
7. The method according to Claim 5, **characterized in that** the connection member is formed from a rod. 25
8. The method according to Claim 6, **characterized in that** the flexible material is a wire or a chain. 30
9. A method for constructing and revamping a blast furnace body, comprising: assembling a new furnace body of a blast furnace to construct the blast furnace body by taking in and stacking ring blocks for the new furnace body in order from the upper ring block, the ring blocks formed by dividing the blast furnace body into plural numbers vertically, **Characterized in that:** 35

respective connection parts of upper and lower ring blocks are temporarily connected by means of a connection tool in advance before the ring blocks are welded and connected, and thereby, the lower ring block is lifted and held on the upper ring block in a step of assembling a new furnace body. 40
10. The method according to Claim 9, **characterized in that**, in the step of assembling the new furnace body, a lower end part of the ring block to be located on an upper side of the ring block newly carried in and 45

an upper end part of the ring block to be located on a lower side are first temporarily connected by means of the connection tool for temporary connection, the upper and lower ring blocks are stacked to assemble the furnace body, and then, the upper and lower ring blocks are centered and aligned with respect to each other to perform welding and connection.

11. A method for constructing and revamping a blast furnace body, comprising: revamping the blast furnace body by cutting an old furnace body of an existing blast furnace into plural numbers vertically, taking out and dismantling the cut plural ring blocks in order from the lower ring block, and then, taking in and stacking ring blocks for the new furnace body in order from the upper ring block, the ring blocks formed by dividing the blast furnace body into plural numbers vertically, to assemble the blast furnace body, **characterized in that:** 50

respective cut parts or connection parts of upper and lower ring blocks are temporarily connected by means of a connection tool in advance before the ring blocks are cut or welded and connected, and thereby, the lower ring block is lifted up and held on the upper ring block in the step from dismantling the old furnace body to assembling the new furnace body. 55
12. The method according to Claim 11, **characterized in that**, in the step of dismantling the old furnace body, for the purpose of dismantling the old furnace body, the connection tool is mounted to plural parts along a cutting line between the lower ring block located on a lower side and the upper ring block located on an upper side of the lower ring block during the cut or in advance to the cut so as to temporarily connect the respective blocks, the ring blocks are completely separated along the cutting line with no uncut part left, and then, the connection tool is cut in carrying the ring blocks out to separate the respective ring blocks in order for the carrying out. 60

FIG.1

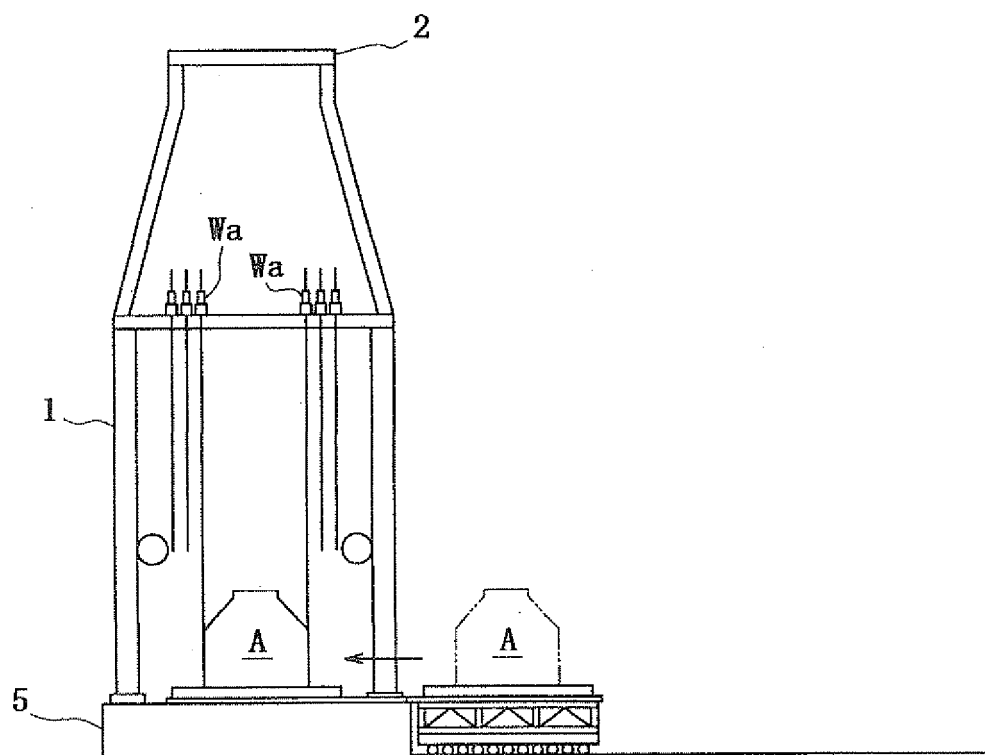


FIG.2

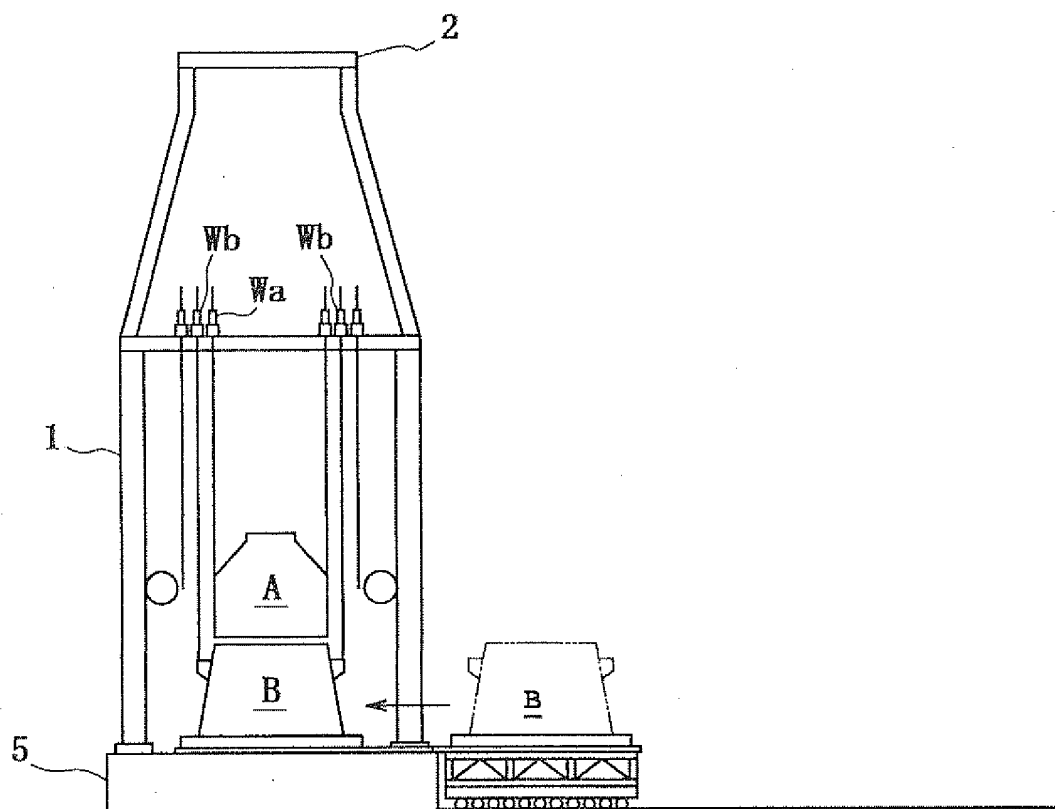


FIG. 3

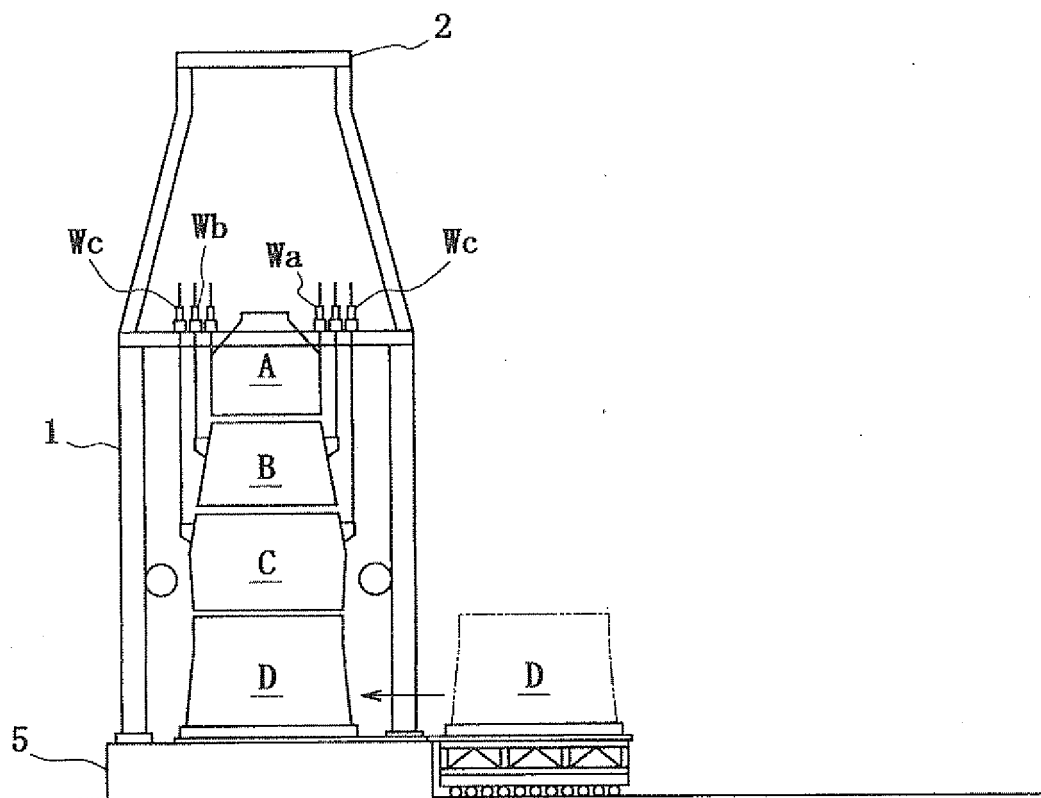


FIG. 4

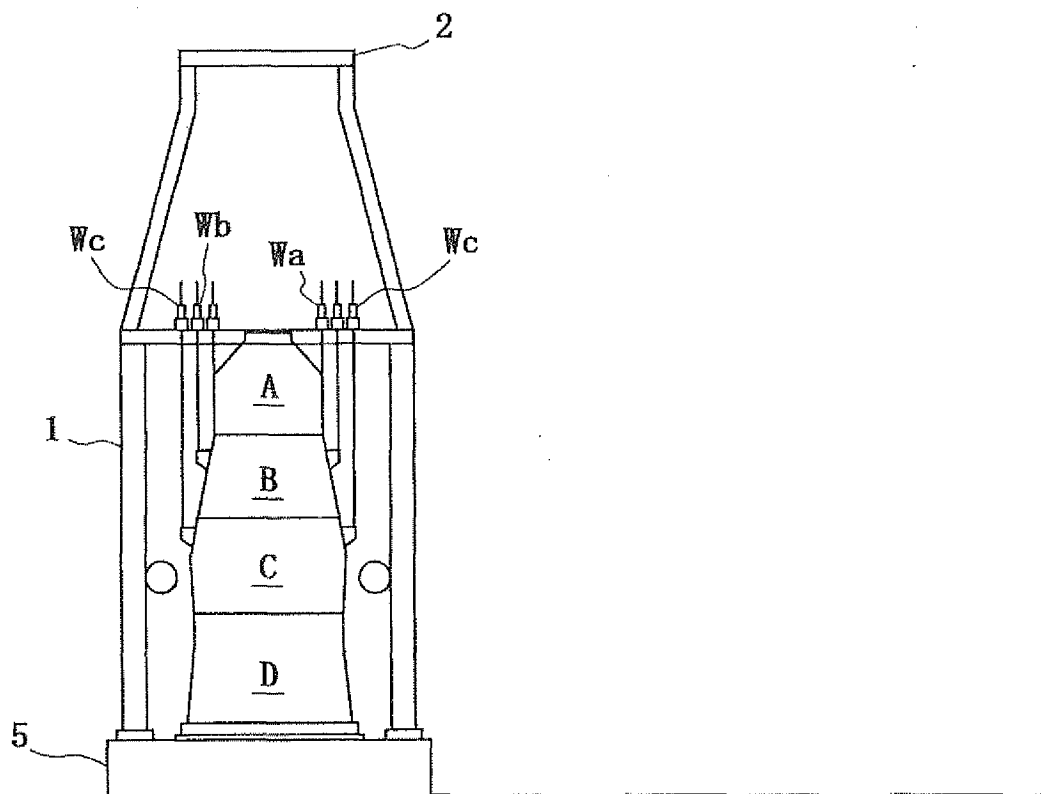


FIG. 5

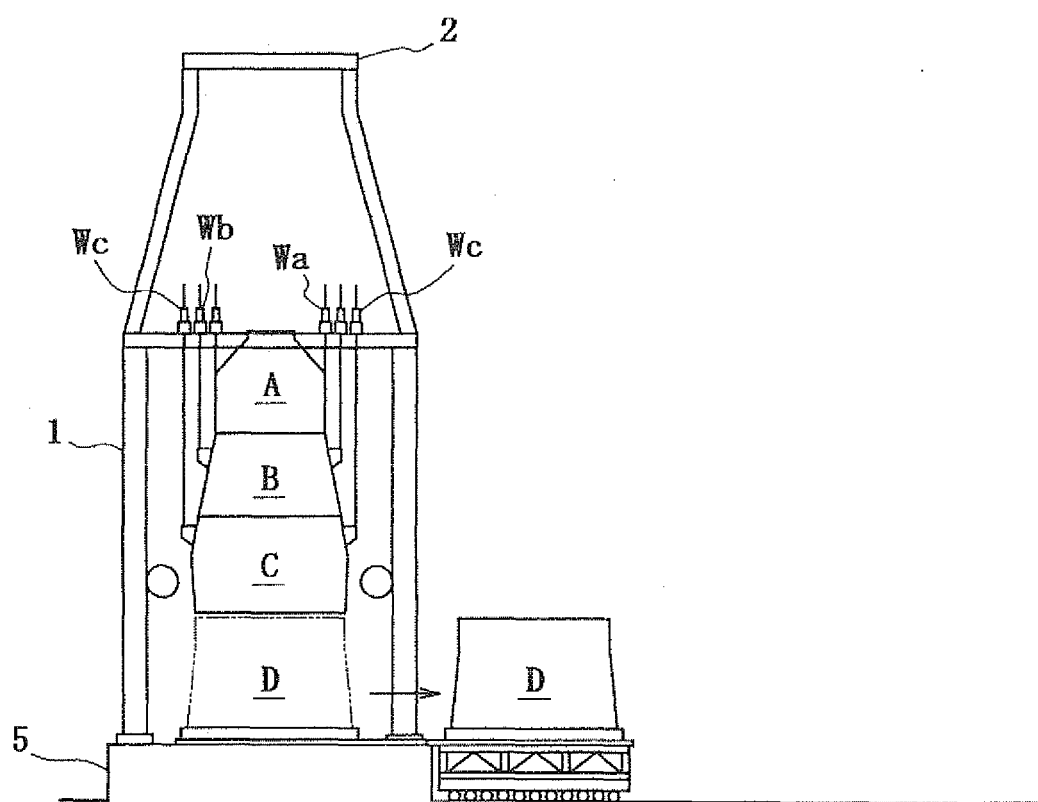


FIG. 6

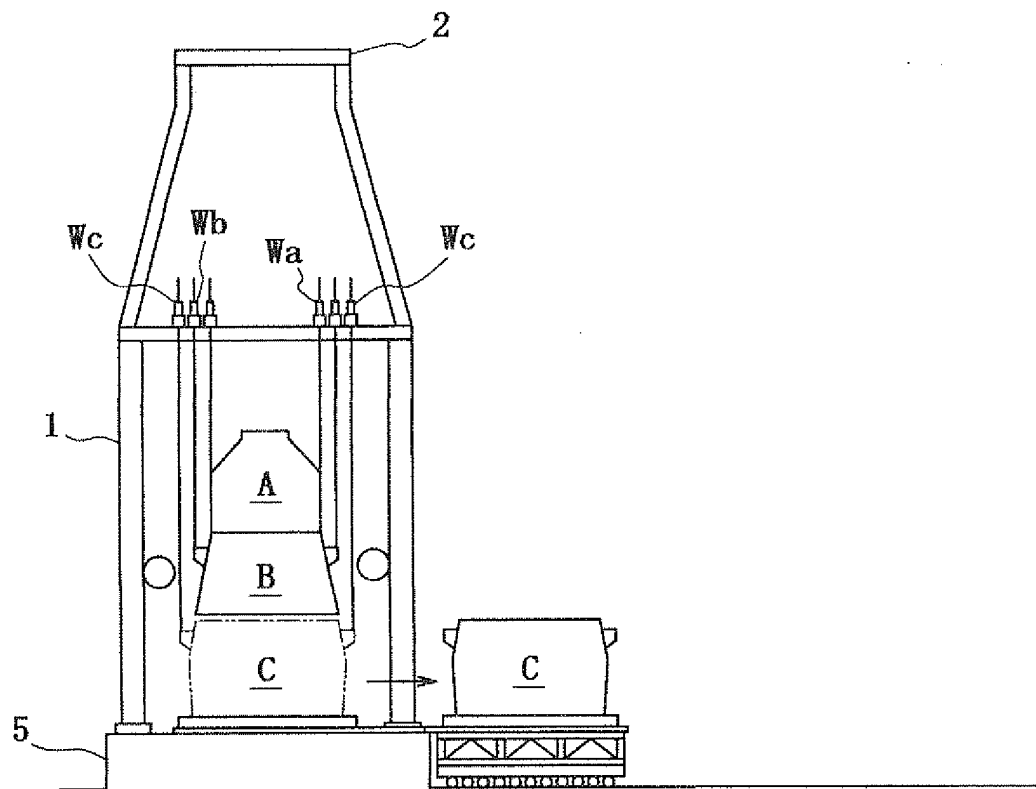


FIG. 7

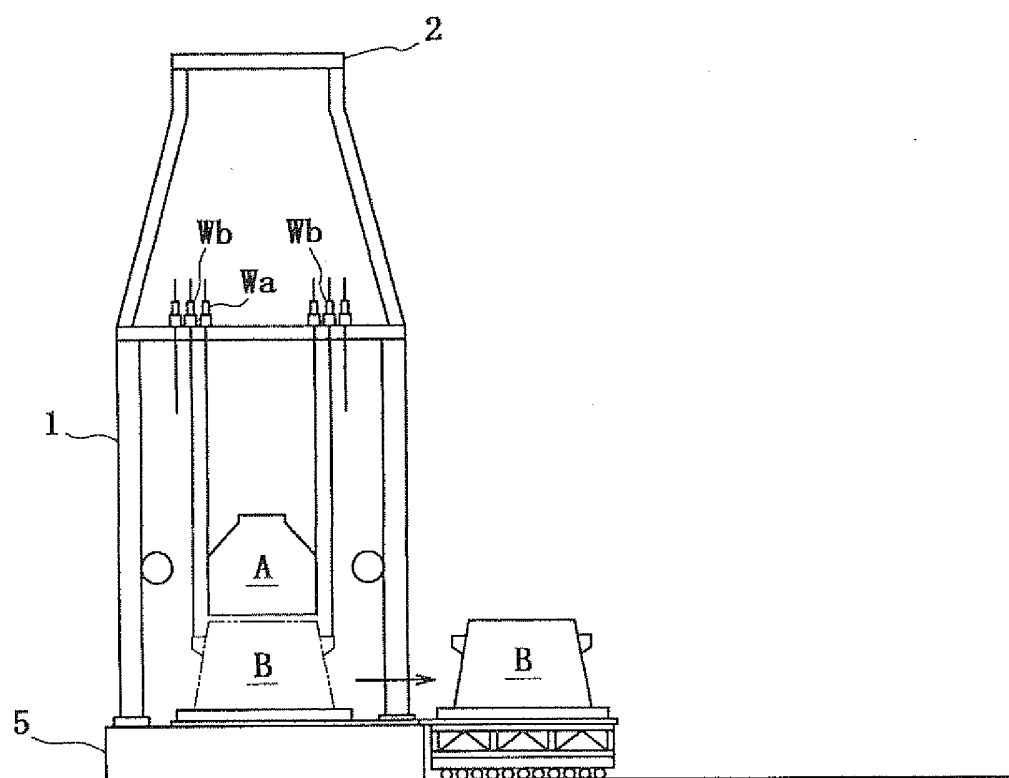


FIG. 8a

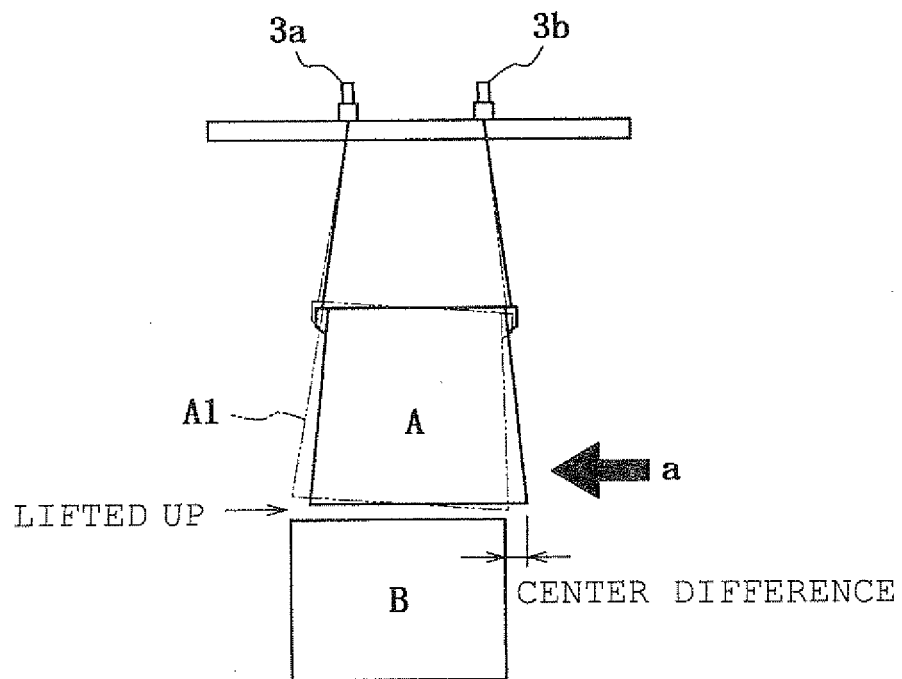


FIG. 8 b

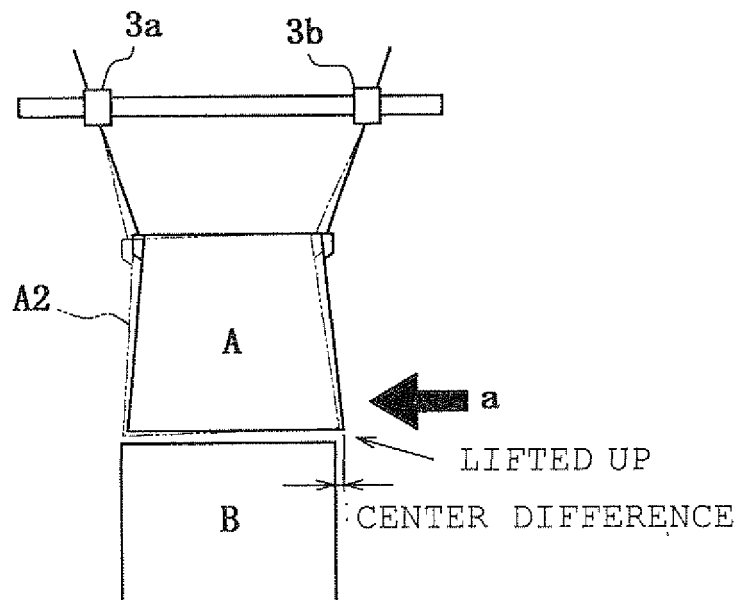


FIG.9

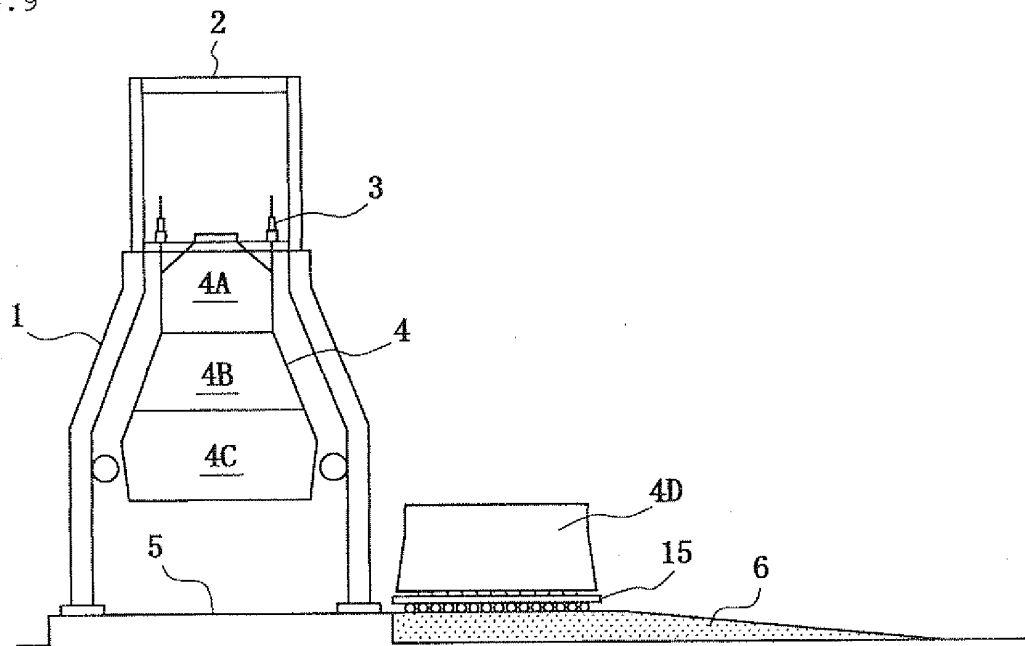


FIG.10

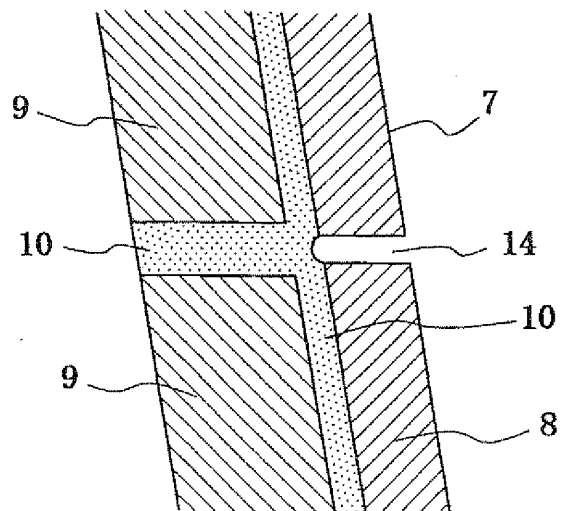


FIG. 11

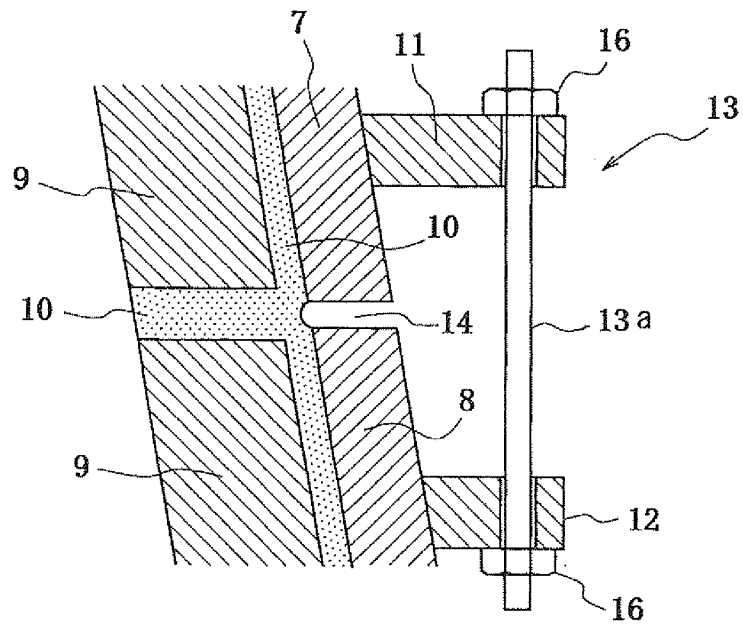


FIG. 12

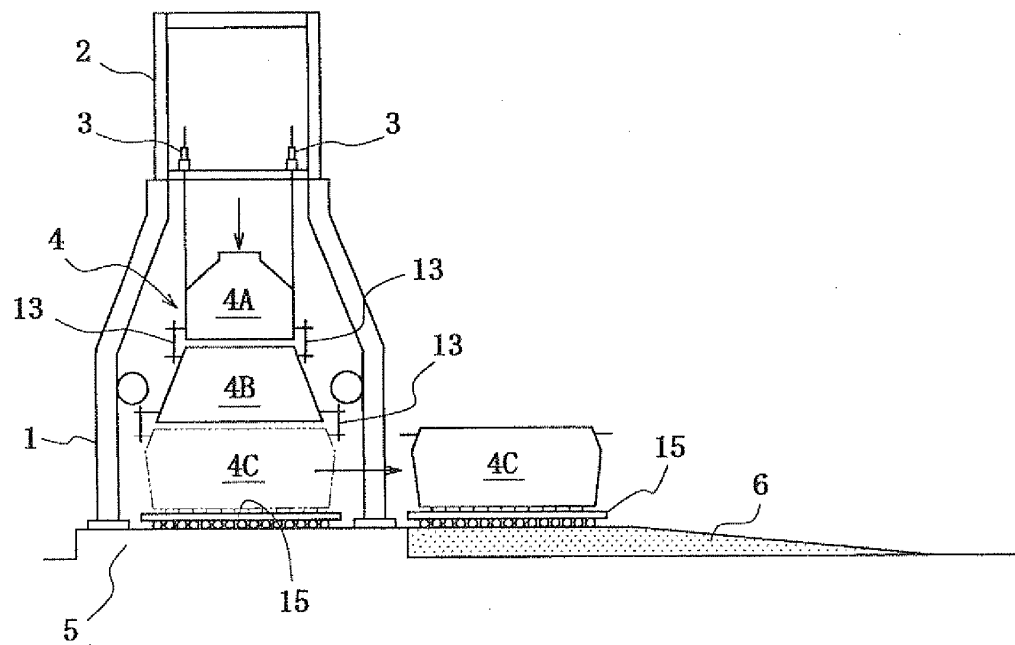


FIG. 13

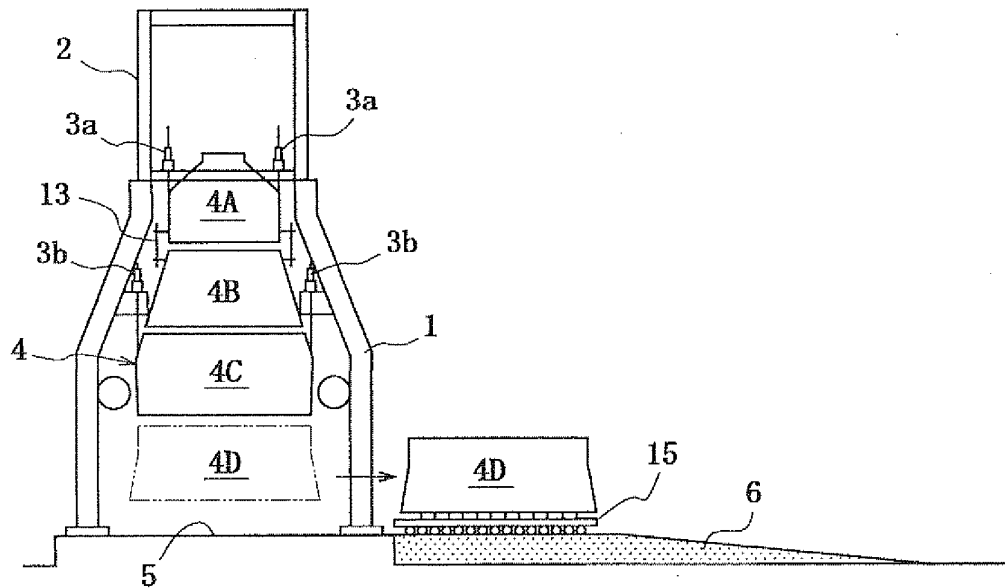


FIG. 14

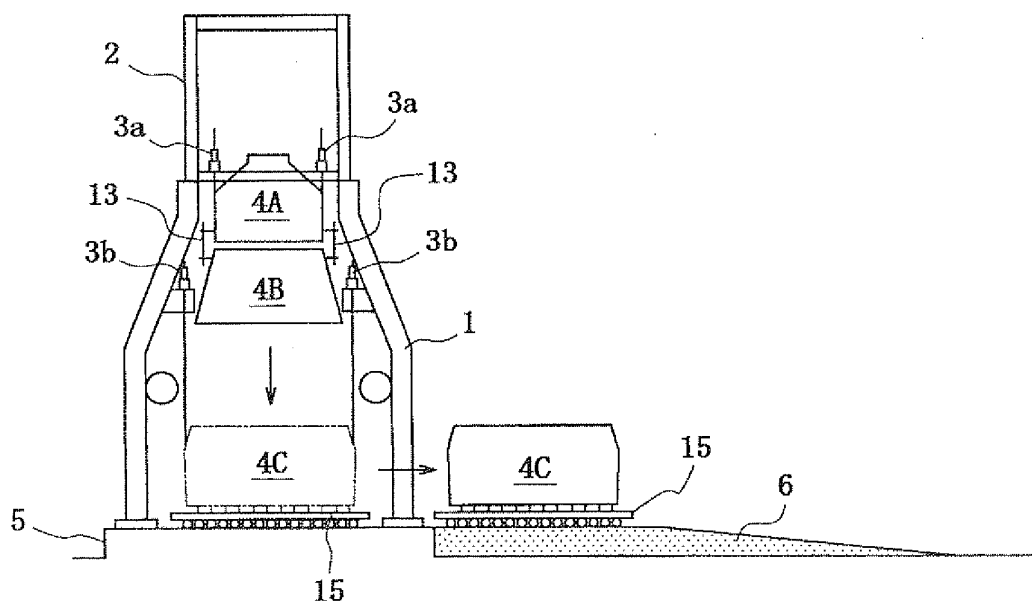


FIG.15

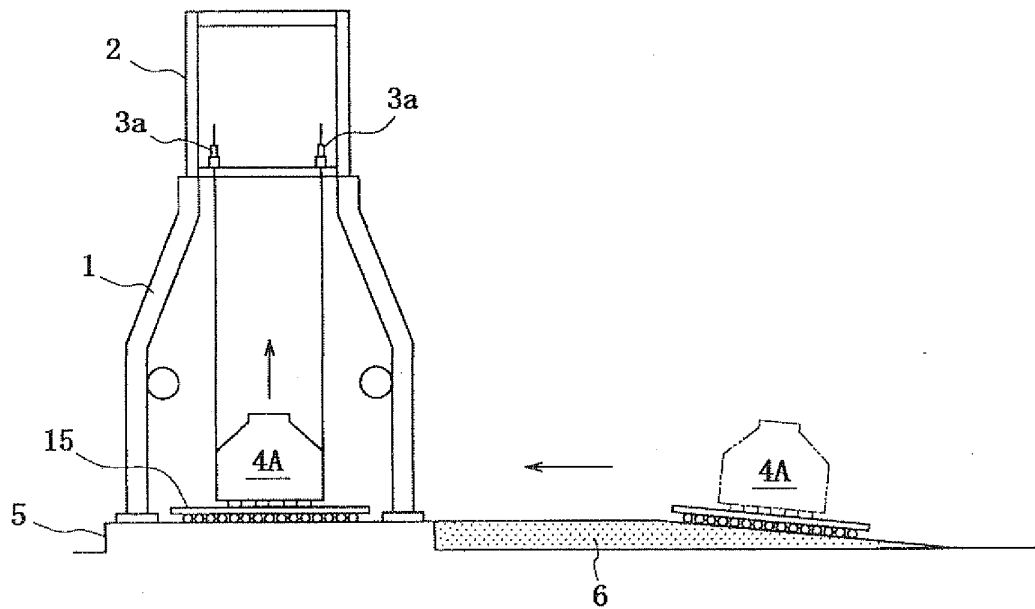


FIG.16

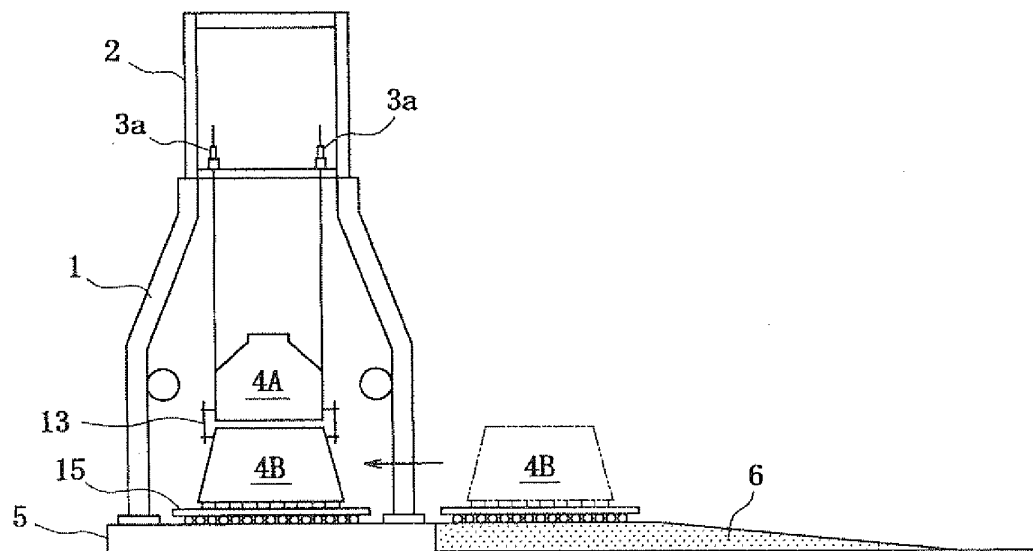


FIG.17

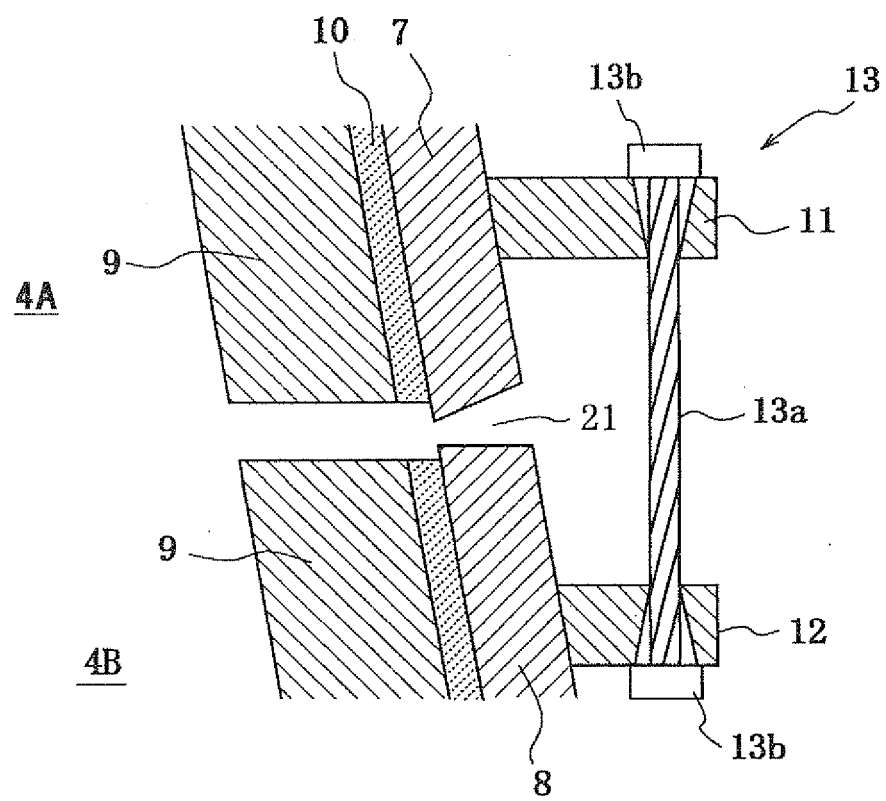


FIG. 18

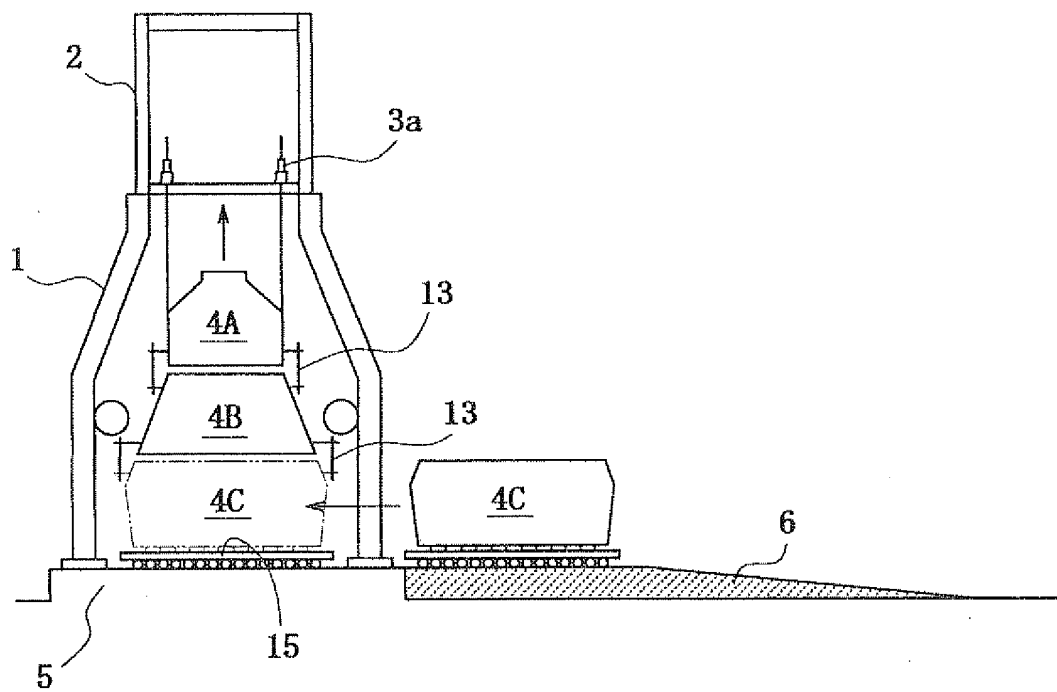


FIG. 19

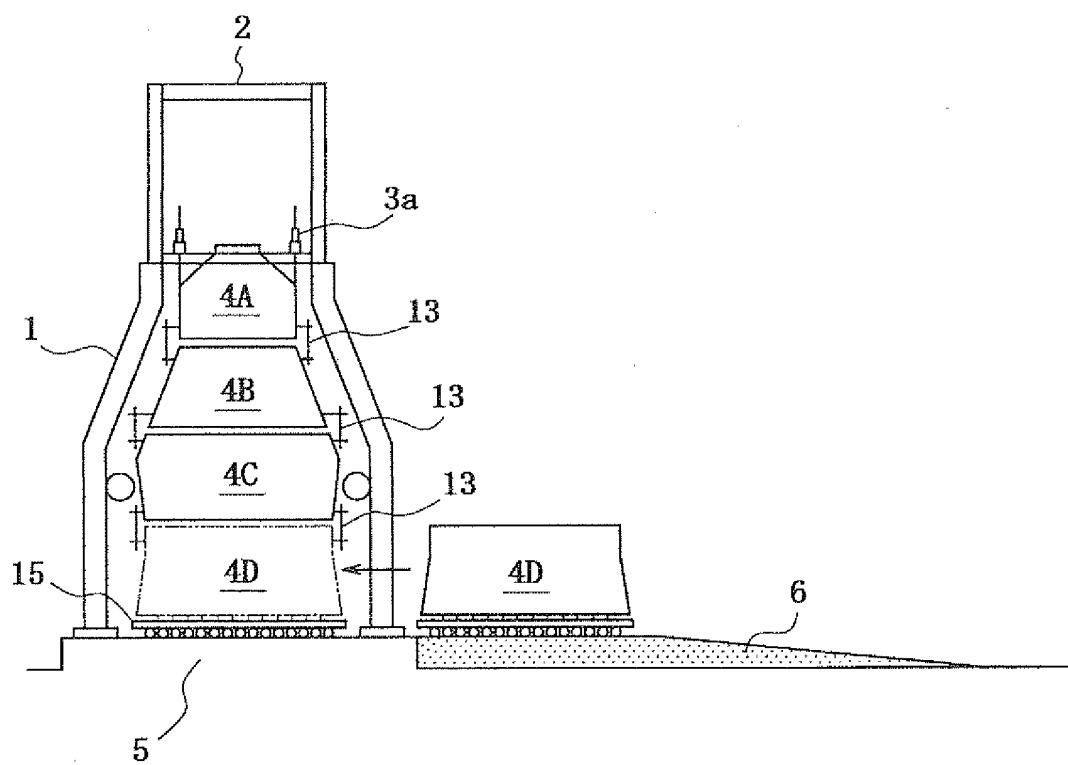


FIG. 20

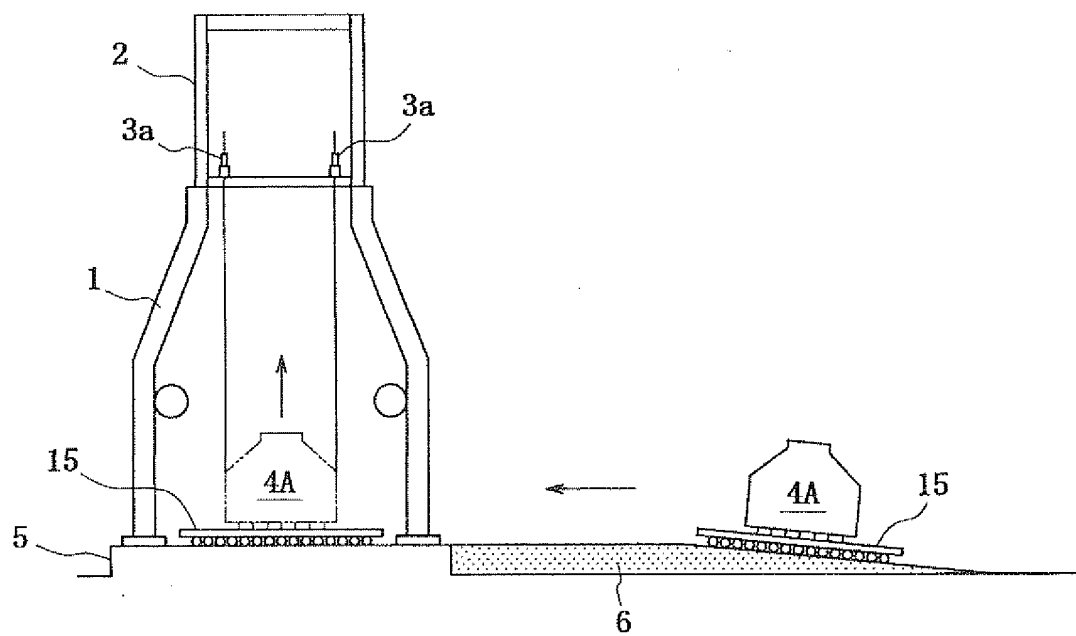


FIG. 21

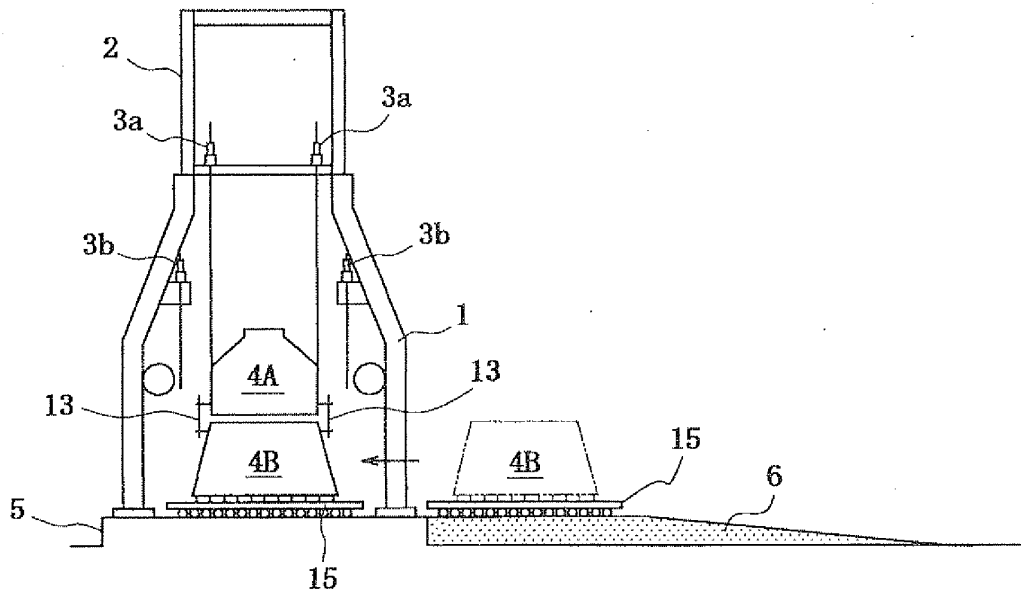


FIG. 22

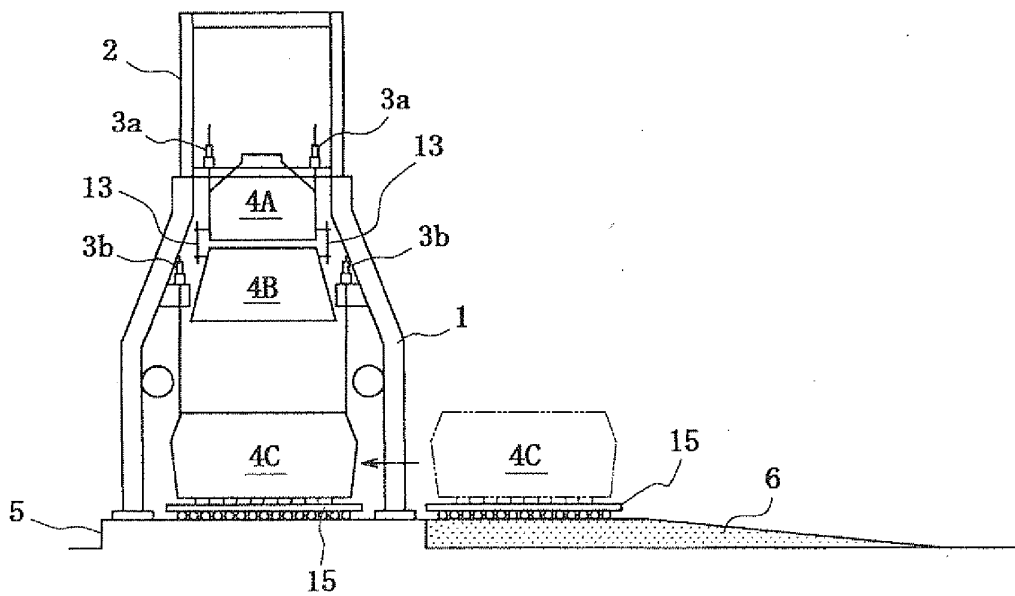


FIG. 23

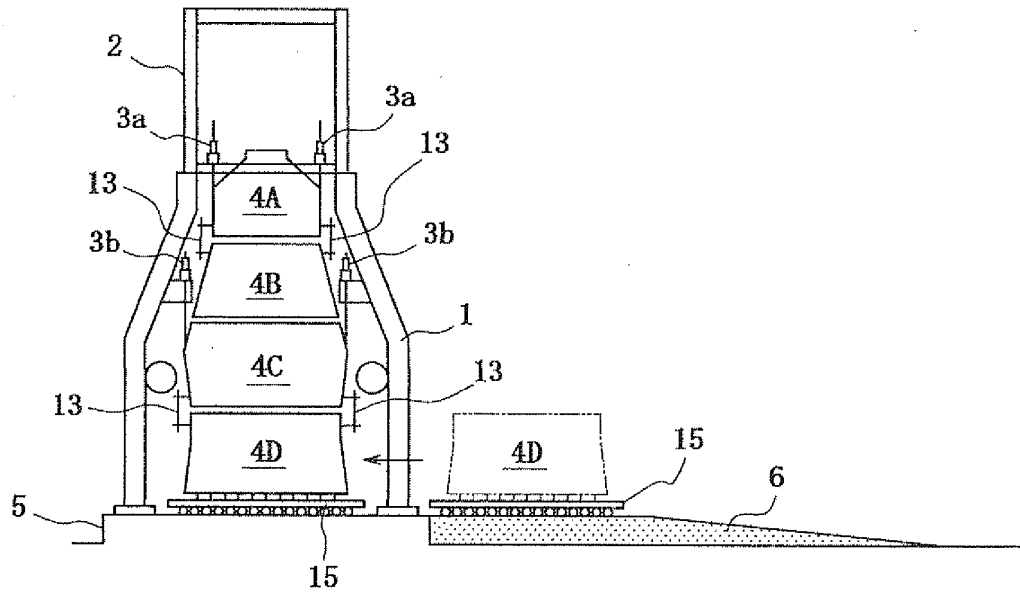


FIG. 24

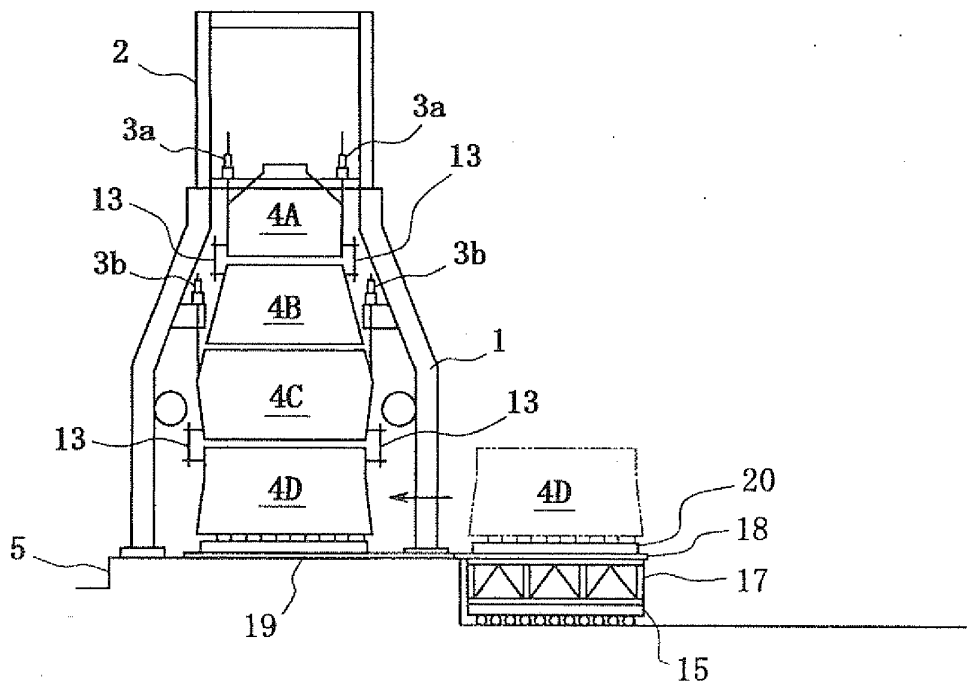


FIG.25

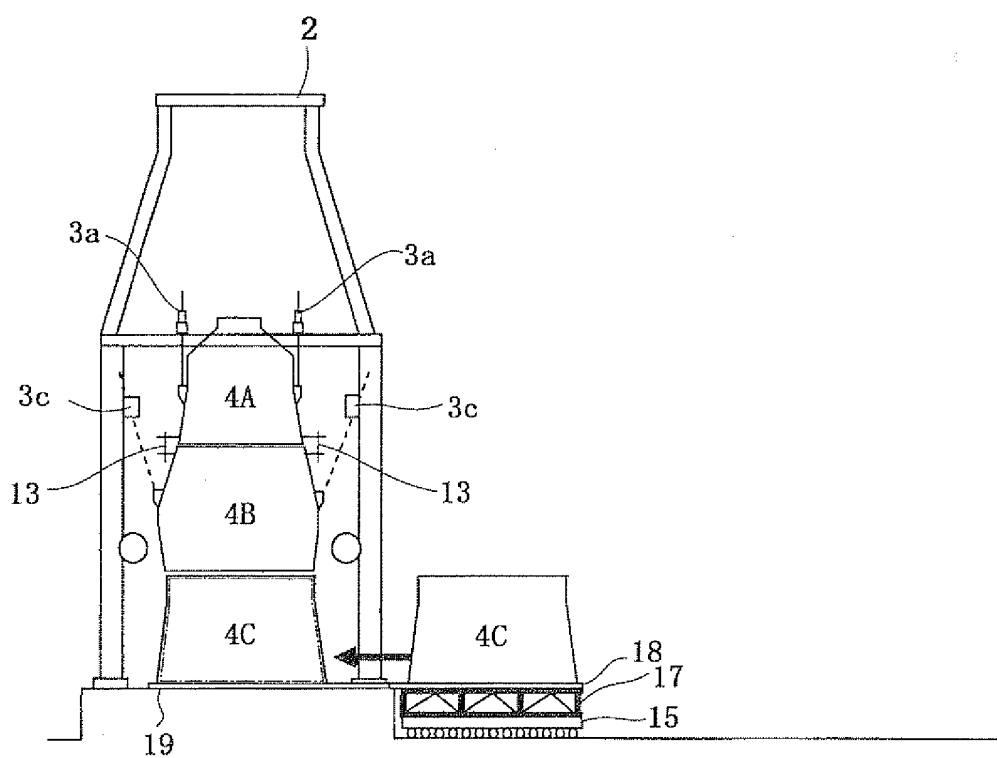


FIG.26 a

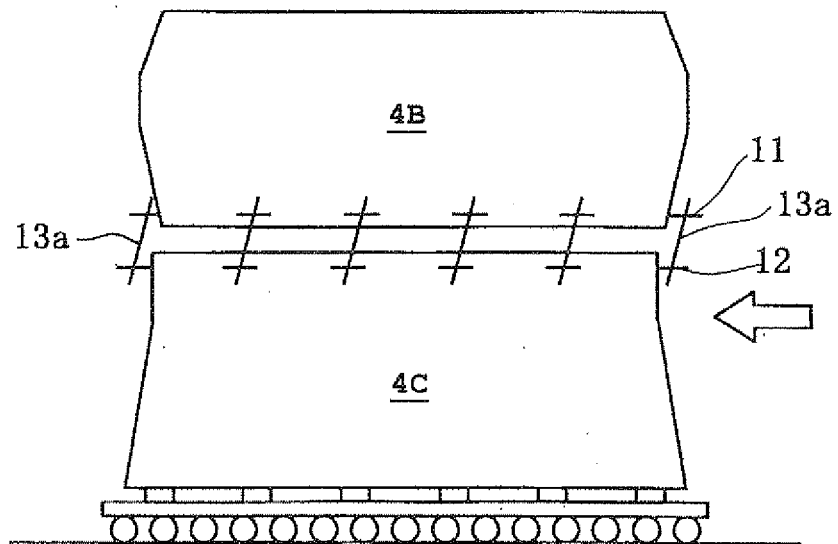


FIG.26 b

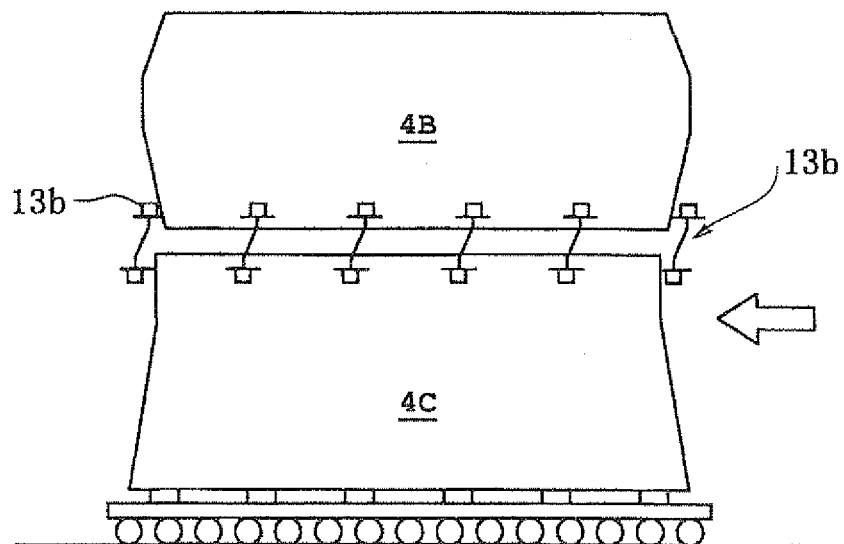
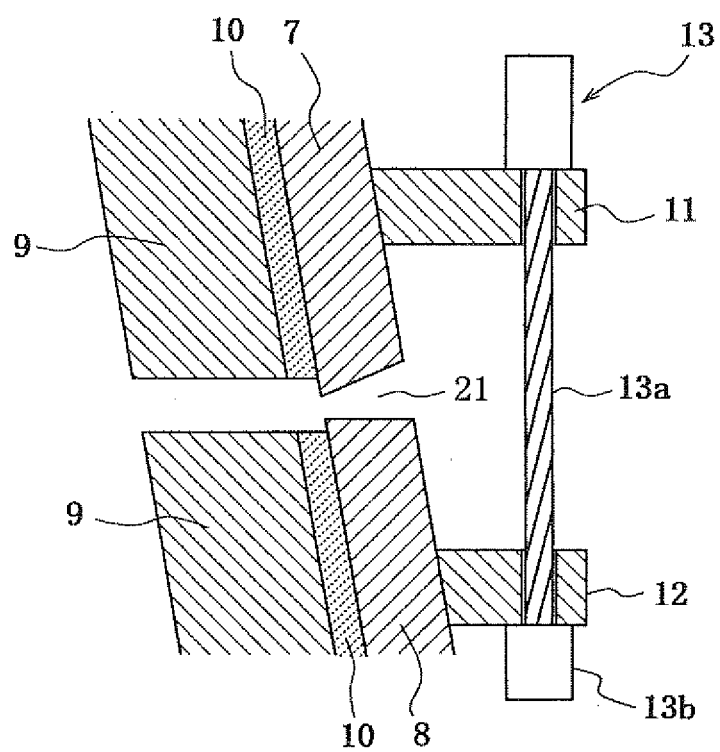


FIG. 27



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/063625

A. CLASSIFICATION OF SUBJECT MATTER C21B7/00 (2006.01) i According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) C21B7/00 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 1996-2009 Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009 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 10-81905 A (Kawasaki Steel Corp.), 31 March, 1998 (31.03.98), Claim 1; Par. No. [0004] (Family: none)	1-12
A	JP 2001-3109 A (Sankyu Inc., Kawasaki Steel Corp.), 09 January, 2001 (09.01.01), Claim 1 (Family: none)	1-12
A	JP 2007-063592 A (JFE Steel Corp.), 15 March, 2007 (15.03.07), Claims 1, 2; Par. Nos. [0013] to [0019] (Family: none)	1-12
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		"1" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
Date of the actual completion of the international search 01 October, 2009 (01.10.09)		Date of mailing of the international search report 13 October, 2009 (13.10.09)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/063625

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2007-126708 A (JFE Steel Corp.), 24 May, 2007 (24.05.07), Claims 1 to 4; Par. Nos. [0017] to [0028] (Family: none)	1-12

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 3165362 B [0010]
- JP 3157723 B [0010]
- JP 3111029 B [0010]
- JP H671999 B [0043]
- JP 2006125563 A [0043]