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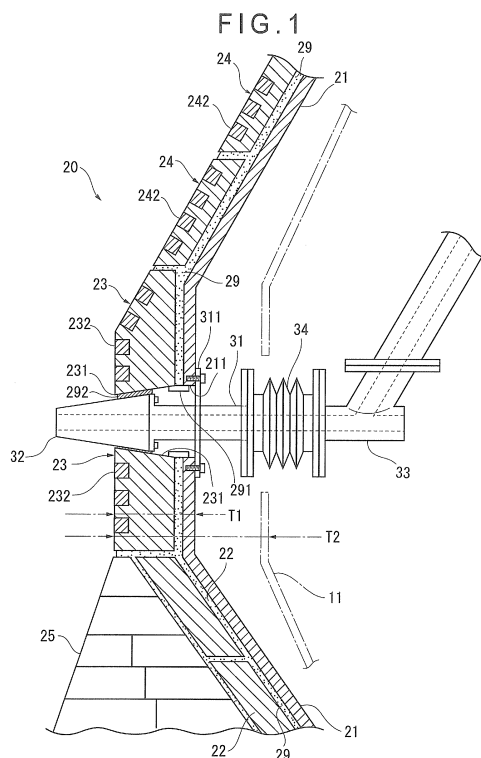
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(54) **STRUCTURE FOR TUYERE SECTION IN BLAST FURNACE**

(57) A a tuyere structure in a blast furnace prevents gas leakage and keeps a position of an end of a tuyere at a predetermined position in a furnace body while absorbing a difference in thermal deformation between the furnace body and a bustle pipe. The tuyere structure (20) in a blast furnace includes: a blowpipe (31) fixed to a furnace shell (21); a tuyere (32) fixed to an end of the blowpipe (31); and a flexible joint (34) that connects the blowpipe 31 to a tuyere stock (33). A tuyere stove-cooler (23) is provided inside the furnace shell (21) around the tuyere (32) to form an inner surface of the blast furnace.



Description

TECHNICAL FIELD

[0001] The present invention relates to a structure of a tuyere section of a blast furnace. Particularly, the invention is usable as a tuyere section of a blast furnace including stave coolers around the tuyere section.

BACKGROUND ART

[0002] A lot of tuyeres are typically provided at a predetermined height of a furnace body in a blast furnace. The tuyeres are respectively connected with blowpipes extending from a bustle pipe disposed around the furnace body. Hot blast is supplied from the blowpipes to the tuyeres and blown through the tuyeres into the furnace (see Patent Literature 1).

[0003] In a typical tuyere section of a blast furnace, as shown in Fig. 3, a tuyere 8 configured to deliver high-temperature air into the furnace is held by a tuyere cooler 9. The tuyere cooler 9 is further held by a tuyere holder 10. The tuyere holder 10 is fixed to a furnace shell 11 on a periphery of the blast furnace.

[0004] Tuyere bricks 5 are disposed surrounding the tuyere cooler 9. The tuyere bricks 5 are formed by combining a plurality of bricks in a manner to surround the tuyere cooler 9. Hearth bricks are laid on a bottom of a hearth of the blast furnace. A hearth wall on the upper side of the hearth is lined with hearth wall bricks 7. The tuyere bricks 5 are installed on the upper side of the hearth wall bricks 7. Further, bosh bricks 6 are installed on the upper side of the tuyere bricks 5.

[0005] A stave cooler 1 is disposed between the bosh bricks 6 and the furnace shell 11 and between the hearth wall bricks 7 and the furnace shell 11. A stave cooler 1a for the tuyere is disposed between the tuyere bricks 5 and the furnace shell 11.

[0006] In the stave coolers 1 and 1a, a plurality of cooling water pipes are provided. Cooling water is supplied via such cooling water pipeline 15. The stave coolers 1 and 1a are cooled by the cooling water flowing in the cooling water pipes, whereby heat from an inside of the furnace is blocked to protect the furnace shell 11.

[0007] The tuyere 8 and the tuyere cooler 9 surrounded by the tuyere bricks 5 are fixed to the furnace shell 11 through the tuyere holder 10. Since the furnace shell 11 is kept at a low temperature by being cooled by the stave coolers, thermal expansion of the furnace shell 11 is small, so that a position of the tuyere 8 is almost constant. On the other hand, the hearth bricks and the hearth wall bricks 7 are heated to a high temperature for storing molten pig iron and slag in the furnace, resulting in thermal expansion. By this thermal expansion, the tuyere bricks 5 installed on the upper side of the hearth wall bricks 7 are pushed upward. In such a structure, the tuyere 8 and the tuyere cooler 9 receive load of upward deformation through the tuyere bricks 5.

[0008] For this reason, a compressible mortar layer 12 is provided between a lower portion of the tuyere cooler 9 and the tuyere bricks 5. When the tuyere bricks 5 are pushed upward by the thermal expansion of the hearth wall bricks 7, the compressible mortar layer 12 is compressed to prevent the pushed tuyere bricks 5 from applying an excessive load onto the tuyere cooler 9.

[0009] A blowpipe 17 is inserted from an outside of the furnace shell 11 into the tuyere holder 10, the tuyere cooler 9 and the tuyere 8. The blowpipe 17 is connected to the bustle pipe disposed around the furnace body via the tuyere stock 18. Hot blast is supplied from the bustle pipe through the tuyere stock 18 and the blowpipe 17 to be blown into the furnace body through the tuyere.

[0010] The blowpipe 17 and the tuyere stock 18 are supported by a furnace tower structure (not shown) provided around the furnace body in conjunction with the bustle pipe. An end of the blowpipe 17 is formed in a convex spherical surface while an inner connection portion of the tuyere 8 to the blowpipe is formed in a concave spherical surface, thereby defining a spherical joint. Connection between the tuyere 8 and the blowpipe 17 by the spherical joint allows mutual displacement of the tuyere 8 and the blowpipe 17 while keeping airtightness therebetween.

[0011] In the above structure shown in Fig. 3, the tuyere 8 is held by the furnace body, namely, the furnace shell 11 through the tuyere cooler 9 and the tuyere holder 10, since it is necessary to maintain a position of the end of the tuyere 8 (i.e., blowing position of hot blast) at a predetermined position inside the furnace body for a proper operation of the blast furnace.

[0012] While the blowpipe 17 and the bustle pipe are supported independently of the furnace body including the tuyere 8, the blowpipe 17 and the tuyere 8 are connected by the spherical surface joint. This is because the furnace body is heated to a high temperature to be thermally deformed while the blowpipe 17 through the bustle pipe are supported by the furnace tower structure to be less thermally deformed, resulting in different thermal deformation behavior.

[0013] The bricks 5, 6 and 7 for protection are piled up on an inner side of the stave coolers 1 and 1a in order to block heat shock at the initial blowing-in and prevent damage from molten pig iron and slag in the furnace. Since the tuyere section is provided penetrating a thickness of the tuyere brick 5 and the stave cooler 1a, a distance from the furnace shell 11 to the tuyere 8 is increased, and the blowpipe 17 is accordingly lengthened.

CITATION LIST

PATENT LITERATURE(S)

[0014] Patent Literature 1: JP-A-2002-220609

SUMMARY OF THE INVENTION

PROBLEM(S) TO BE SOLVED BY THE INVENTION

[0015] When the spherical surface joint is used for connection between the blowpipe 17 and the tuyere 8 as described above, the end of the blowpipe 17 is inserted from the outside of the furnace shell 11 into the tuyere 8, leading to the connection by the spherical surface joint. In the connected spherical surface joint, mutual displacement of the blowpipe 17 and the tuyere 8 is allowable while keeping airtightness.

[0016] However, the spherical surface joint requires a highly accurate processing for forming a spherical surface capable of ensuring airtightness since the airtightness is kept by metal touch connection of the spherical surfaces around an air hole, resulting in an increase in production cost. Moreover, even with such metal touch connection, gas leaks when high pressure is applied.

[0017] Particularly, since the distance from the furnace shell 11 to the tuyere 8 is long and the blowpipe 17 is formed longer by the distance, the blowpipe 17 is supported in a state of a cantilever. Accordingly, the position of the end of the blowpipe 17 is easily displaced, which may cause difficulty in suitably keeping airtightness of the tuyere 8 to the spherical surface joint.

[0018] Further, the tuyere 8 is disposed on an inner surface of the furnace while being supported by the tuyere cooler 9. In a typical arrangement of the tuyere 8, the tuyere cooler 9 or the tuyere holder 10 is machined for adjustment so that all of the circumferentially arranged tuyeres 8 evenly face the center of the furnace.

[0019] However, the tuyere 8 and the tuyere cooler 9 supporting the tuyere 8 are surrounded by the bricks 5 for protection and spaced away from the stove coolers 1 and 1a. This arrangement may cause thermal deformation of the tuyere cooler 9. Accordingly, the position of the tuyere 8 on the inner surface of the furnace or a posture of the tuyere 8 may be shifted by the thermal deformation.

[0020] When the position of the tuyere 8 on the inner surface of the furnace is shifted, uniformity in the circumferential direction of a raceway inside the furnace, which is crucial for the operation of the blast furnace, is broken, so that a stable operation (e.g., reduction reaction and stock movement) cannot be obtained.

[0021] An object of the invention is to provide a structure of a tuyere section in a blast furnace, the tuyere section capable of preventing gas leakage and keeping a position of an end of a tuyere at a predetermined position in a furnace body while absorbing a difference in thermal deformation between the furnace body and a bustle pipe.

MEANS FOR SOLVING THE PROBLEM(S)

[0022] A tuyere structure of a blast furnace according to an aspect of the invention includes: a blowpipe fixed

to a furnace shell; a tuyere fixed to an end of the blowpipe; and a flexible joint that connects the blowpipe to a tuyere stock.

[0023] With this arrangement, since the tuyere is fixed to the end of the blowpipe, metal touch connection between the tuyere and the blowpipe can be eliminated. Accordingly, the spherical surface processing required for the metal touch connection can be eliminated to reduce the production cost. Moreover, gas leakage caused by the metal touch connection can be prevented.

[0024] Furthermore, since the blowpipe is fixed to the furnace shell, the position of the tuyere fixed to the end of the blowpipe relative to the furnace shell, in other words, the position of the end of the tuyere in the furnace body can be kept at a predetermined position.

[0025] In addition, since the flexible joint is interposed between the blowpipe and the tuyere stock, the flexible joint can absorb a difference in thermal deformation between the furnace body and the bustle pipe.

[0026] With this arrangement, gas leakage can be prevented and the position of the end of the tuyere can be kept at the predetermined position in the furnace body while the difference in thermal deformation between the furnace body and the bustle pipe is absorbed.

[0027] In the above aspect of the invention, it is preferable that a stove cooler is provided inside the furnace shell around the tuyere and forms an inner surface of the blast furnace.

[0028] When the distance between the tuyere and the furnace shell to which the blowpipe is fixed is large, the blowpipe may be cantilevered to displace the position of the end of the tuyere. In contrast, in the above aspect of the invention, since conventional tuyere bricks are omitted and the stove cooler directly serves as an inner surface of the furnace, the length of the blowpipe can be minimized and displacement of the position of the tuyere can be inhibited.

[0029] In the above aspect of the invention, it is preferable that an opening for the tuyere is formed on the furnace shell around the tuyere and is connected with an entire periphery of a flange formed on a periphery of the blowpipe.

[0030] When the flange is attached to the opening for the tuyere, it is desirable to use bolts disposed on the flange at a predetermined interval for the convenience of attachment and detachment for maintenance.

BRIEF DESCRIPTION OF DRAWING(S)

[0031]

Fig. 1 is a cross-sectional view showing an exemplary embodiment of the invention.

Fig. 2 is a cross-sectional view showing another exemplary embodiment of the invention.

Fig. 3 is a cross-sectional view showing a conventional example.

DESCRIPTION OF EMBODIMENT(S)

[0032] An exemplary embodiment of the invention will be described below with reference to the drawings.

[0033] As shown in Fig. 1, a tuyere structure (structure of tuyere section) 20 in the exemplary embodiment includes: a blowpipe 31 fixed to a furnace shell 21; a tuyere 32 fixed to an end of the blowpipe 31; and a flexible joint 34 that connects the blowpipe 31 to a tuyere stock 33.

[0034] Since high-temperature and high-pressure hot blast to be supplied into the blast furnace passes through an inside of the flexible joint 34, a flexible joint in a form of metal bellows is used as the flexible joint 34.

[0035] A flange to which the tuyere is attached is formed at an end of the blowpipe 31. The tuyere 32 is fixed to the flange by bolts and the like.

[0036] The blowpipe 31 has a flange at an opposite end from the tuyere 32. The flexible joint 34 is connected to this flange. The flexible joint 34 has a flange at an opposite end from the blowpipe 31. The tuyere stock 33 is connected to this flange. An opposite end of the tuyere stock 33 from the flexible joint 34 is connected to a bustle pipe (not shown).

[0037] The blowpipe 31 and the tuyere 32 are supported by the furnace shell 21. The tuyere stock 33 and the flexible joint 34 are supported by the bustle pipe (not shown). By supplying hot blast from the bustle pipe, the hot blast can be delivered through the tuyere stock 33, the flexible joint 34 and the blowpipe 31 to the tuyere 32 and can be blown out through the tuyere 32.

[0038] Note that a direction and a position of the tuyere 32 relative to the blowpipe 31 are adjusted in advance so that the direction and the position of the tuyere 32 is set at an appropriate value when the tuyere 32 is disposed in the furnace.

[0039] An tuyere opening 211 (an opening for the tuyere) is formed on the furnace shell 21. A flange 311 is formed on a periphery of the blowpipe 31.

[0040] The end (near the tuyere 32) of the blowpipe 31 is inserted from the tuyere opening 211 to an inside of the furnace (left side in the figure), so that the flange 311 closes the tuyere opening 211.

[0041] The flange 311 is fixed to a periphery of the tuyere opening 211 by bolts at a predetermined interval, resulting in airtight connection.

[0042] By the connection between the flange 311 and the periphery of the tuyere opening 211, the blowpipe 31 is fixed to the furnace shell 21.

[0043] Inside the furnace shell 21, a hearth stove-cooler 22, a tuyere stove-cooler 23 and a bosh stove-cooler 24 are provided.

[0044] The tuyere stove-cooler 23 has a cutout 231 through which the tuyere is inserted. The blowpipe 31 and the tuyere 32 inserted inside the furnace shell 21 through the tuyere opening 211 pass through the cutout 231 to be disposed in a manner to be surrounded by the tuyere stove-cooler 23.

[0045] Inside of the hearth stove-cooler 22 is lined with

hearth wall bricks 25.

[0046] Refractory blocks (e.g., tuyere bricks 5 in Fig. 3) are not provided inside the tuyere stove-cooler 23 and the bosh stove-cooler 24. Instead, refractory blocks 232 and 242 are respectively fit into furnace-interior surfaces (inner surface of the furnace) of the tuyere stove-cooler 23 and the bosh stove-cooler 24.

[0047] By using the tuyere stove-cooler 23, in the exemplary embodiment, a thickness T1 from the furnace shell 21 to the furnace-interior surface is smaller than a thickness T2 (shown in a chain line in the figure) from a furnace shell 11 to the furnace-interior surface in the conventional blast furnace.

[0048] When the thickness T1 from the furnace shell 21 to the furnace-interior surface is decreased, a lever length (i.e. the length for the blowpipe 31 and the tuyere 32 penetrating the thickness T1 to be supported in a cantilevered manner) can be reduced. Accordingly, shifting of the position of the tuyere 32 on the furnace-interior surface is reducible, which is effective for a stable operation.

[0049] Moreover, by replacing the refractory blocks provided inside the furnace (e.g., tuyere bricks 5 in Fig. 3) with the tuyere stove-cooler 23, the tuyere 32 can be inhibited from being pushed up due to thermal deformation of the refractory blocks.

[0050] In the exemplary embodiment, the surface of the tuyere stove-cooler 23 defines the furnace-interior surface that is defined in conformity with a profile suitable for the blast furnace. Accordingly, the surface of the tuyere stove-cooler 23 (i.e., the furnace-interior surface) stays at the same level as the surface of the tuyere brick 5 (see Fig. 3). In the exemplary embodiment, the thickness of the tuyere section is reduced by positioning the furnace shell 21 close to the furnace-interior surface as compared with the conventional furnace shell 11 (i.e. by decreasing a diameter at the tuyere section of the furnace body).

[0051] A refractory filler 29 (e.g., refractory mortar) is fed between the furnace shell 21 and the stable coolers (i.e. the hearth stove-cooler 22, the tuyere stove-cooler 23 and the bosh stove-cooler 24).

[0052] A seal plate 291 is disposed inside the cutout 231 through which the tuyere is inserted and the tuyere opening 211. The seal plate 291 blocks the refractory filler 29 fed inside the furnace shell 21, so that a space defined by the cutout 231, the tuyere opening 211 and the blowpipe 31 is not filled with the filler but kept hollow.

[0053] On the other hand, an elastic refractory material 292 (e.g., ceramic wool) is interposed between the cutout 231 and the tuyere 32.

[0054] The assembly process of the exemplary embodiment is as follows.

[0055] Firstly, the furnace shell 21 is built to define an outline of the furnace body. Then, the hearth stove-cooler 22 and the hearth wall brick 25 are installed inside the furnace shell 21. Subsequently, the tuyere stove-cooler 23 and the bosh stove-cooler 24 are installed on the up-

per side of the hearth stove-cooler 22 and the hearth wall brick 25.

[0056] Herein, the refractory material 292 is attached to the inside of the cutout 231 of the tuyere stove-cooler 23 and the seal plate 291 is provided to the inside of the cutout 231 and the tuyere opening 211.

[0057] Next, the tuyere stock 33, the flexible joint 34, the blowpipe 31 and the tuyere 32 are assembled outside of the furnace. The assembled tuyere stock 33 and the tuyere 32 are placed in front of the tuyere opening 211 and then the tuyere 32 and the blowpipe 31 are introduced into the furnace.

[0058] Then, the refractory material 292 is interposed between the cutout 231 and the tuyere 32. The tuyere 32 and the blowpipe 31 are disposed in the cutout 231, through which the tuyere is inserted, of the tuyere stove-cooler 23. At this time, the tuyere 32 projects from the tuyere stove-cooler 23 to the inside of the furnace.

[0059] In this state, the flange 311 of the blowpipe 31 is fixed to the periphery of the tuyere opening 211.

[0060] After the above process, the refractory filler 29 is fed inside the furnace shell 21. The construction of the tuyere structure is thus completed.

[0061] Since the refractory filler 29 fed inside the furnace shell 21 is blocked by the seal plate 291 inside the cutout 231 and the tuyere opening 211, the surroundings of the blowpipe 31 are left without being filled with the refractory filler 29.

[0062] By securing this space, when the tuyere is damaged during the operation, the tuyere 32 can be easily replaced by removing the flexible joint 34 after stopping hot blast supply and subsequently pulling the blowpipe 31 and the tuyere 32 out of the furnace shell 31.

[0063] As the seal plate 291, for instance, a metallic plate and an elastomer material (e.g., heat-resisting rubber) are usable.

[0064] According the exemplary embodiment, the following advantages are obtainable.

[0065] Since the tuyere 32 is fixed to the end of the blowpipe 31, a conventionally employed metal touch connection between the tuyere 32 and the blowpipe 31 can be eliminated. Accordingly, the spherical surface processing required for the metal touch connection can be eliminated to decrease the production cost. Moreover, gas leakage caused by the metal touch connection can be prevented.

[0066] Moreover, since the blowpipe 31 is fixed to the furnace shell 21, the position of the tuyere 32 fixed to the end of the blowpipe 31 relative to the furnace shell 21, in other words, the position of the end of the tuyere 32 in the furnace body can be kept at a predetermined position.

[0067] In addition, since the flexible joint 34 is interposed between the blowpipe 31 and the tuyere stock 33, the flexible joint can absorb a difference in thermal deformation between the furnace body and the bustle pipe.

[0068] With this arrangement, gas leakage can be prevented and the position of the end of the tuyere 32 can be kept at a predetermined position in the furnace body

while a difference in thermal deformation between the furnace body and the bustle pipe can be absorbed.

[0069] Since the tuyere stove-cooler 23 is provided around the tuyere 32 inside the furnace shell 21 and defines the furnace-interior surface, conventionally required tuyere bricks can be omitted, thereby decreasing the thickness of the furnace body by the thickness of the tuyere bricks, so that a distance between the furnace shell 21 to which the blowpipe 31 is fixed and the tuyere 32 can be reduced.

[0070] When the distance between the tuyere 32 and the furnace shell 21 to which the blowpipe 31 is fixed is large, the blowpipe 31 may be cantilevered to cause a large displacement of the position of the tuyere 32. In contrast, in the exemplary embodiment, since the conventionally required tuyere bricks (see Fig. 3) are omitted and the tuyere stove cooler 23 directly serves as the furnace-interior surface, the length of the blowpipe 31 can be minimized and displacement of the position of the tuyere 32 can be inhibited.

[0071] Since the tuyere opening 211 is formed on the furnace shell 21 around the tuyere 32 and the entire periphery of the flange 311 formed on the periphery of the blowpipe 31 is connected to the tuyere opening 211, the blowpipe 31 can be fixed to the furnace shell 21 at a predetermined posture and gas leakage from the tuyere opening 211 also can be prevented.

[0072] For connection between the flange 311 and the tuyere opening 211, since the bolts disposed on the flange 311 at a predetermined interval are used, the attachment and detachment for maintenance can easily be conducted.

[0073] The invention is not limited to the above embodiment but includes other embodiments or modifications or the like without departing from an object of the invention.

[0074] For instance, although the blowpipe 31 and the tuyere 32 are disposed substantially orthogonal to the furnace shell 21, the tuyere 32 is often inclined down toward the hearth in practical use. Accordingly, the tuyere 32 may be attached to the blowpipe 31 in an inclined manner, or the blowpipe 31 may be fixed to the furnace shell 21 in an inclined manner.

[0075] For instance, in another exemplary embodiment shown in Fig. 2, the end of the blowpipe 31 is bent toward the hearth and the tuyere 32 connected to the end is inclined toward the hearth. For insertion of the inclined tuyere 32, the cutout 231 formed in the tuyere stove-cooler 23 is also formed in an inclined manner. Note that the other arrangements in the exemplary embodiment shown in Fig. 2 are the same as those in exemplary embodiment of Fig. 1.

[0076] In order to use the surfaces of the tuyere stove-cooler 23 and the bosh stove-cooler 24 as the furnace-interior surface, the refractory blocks 232 and 242 are respectively provided to the tuyere stove-cooler 23 and the bosh stove-cooler 24 for protection of the surfaces thereof. However, the arrangement of the refractory

blocks 232 and 242 is not limited to such an intermittent arrangement, but may be disposed continuously to each other. Alternatively, the refractory blocks 232 and 242 may be omitted when the surfaces of the stave coolers 23 and 24 can be sufficiently protected by a protection layer formed by a refractory material coating and the like over the surfaces of the stave coolers 23 and 24. 5

[0077] It should be understood that specific shape, material size and the like in the exemplary embodiment may be altered as needed in implementation of the invention. 10

EXPLANATION OF CODE(S)

[0078]

	15
20... a tuyere structure	
21... furnace shell	
211...tuyere opening	
22...hearth stave-cooler	
23...tuyere stave-cooler	20
231... cutout	
232...refractory block	
24...bosh stave-cooler	
25...hearth wall brick	
29... refractory filler	25
291... seal plate	
292... refractory material	
31... blowpipe	
311...flange	
32... tuyere	30
33...tuyere stock	
34... flexible joint	

Claims 35

1. A tuyere structure of a blast furnace, comprising:

a blowpipe fixed to a furnace shell;
a tuyere fixed to an end of the blowpipe; and 40
a flexible joint that connects the blowpipe to a tuyere stock.

2. The tuyere structure of the blast furnace according to claim 1, wherein 45 a stave cooler is provided inside the furnace shell around the tuyere and forms an inner surface of the blast furnace.

3. The tuyere structure of the blast furnace according to claim 1 or 2, wherein 50 an opening for the tuyere is formed on the furnace shell around the tuyere and is connected with an entire periphery of a flange formed on a periphery of the blowpipe. 55

FIG. 1

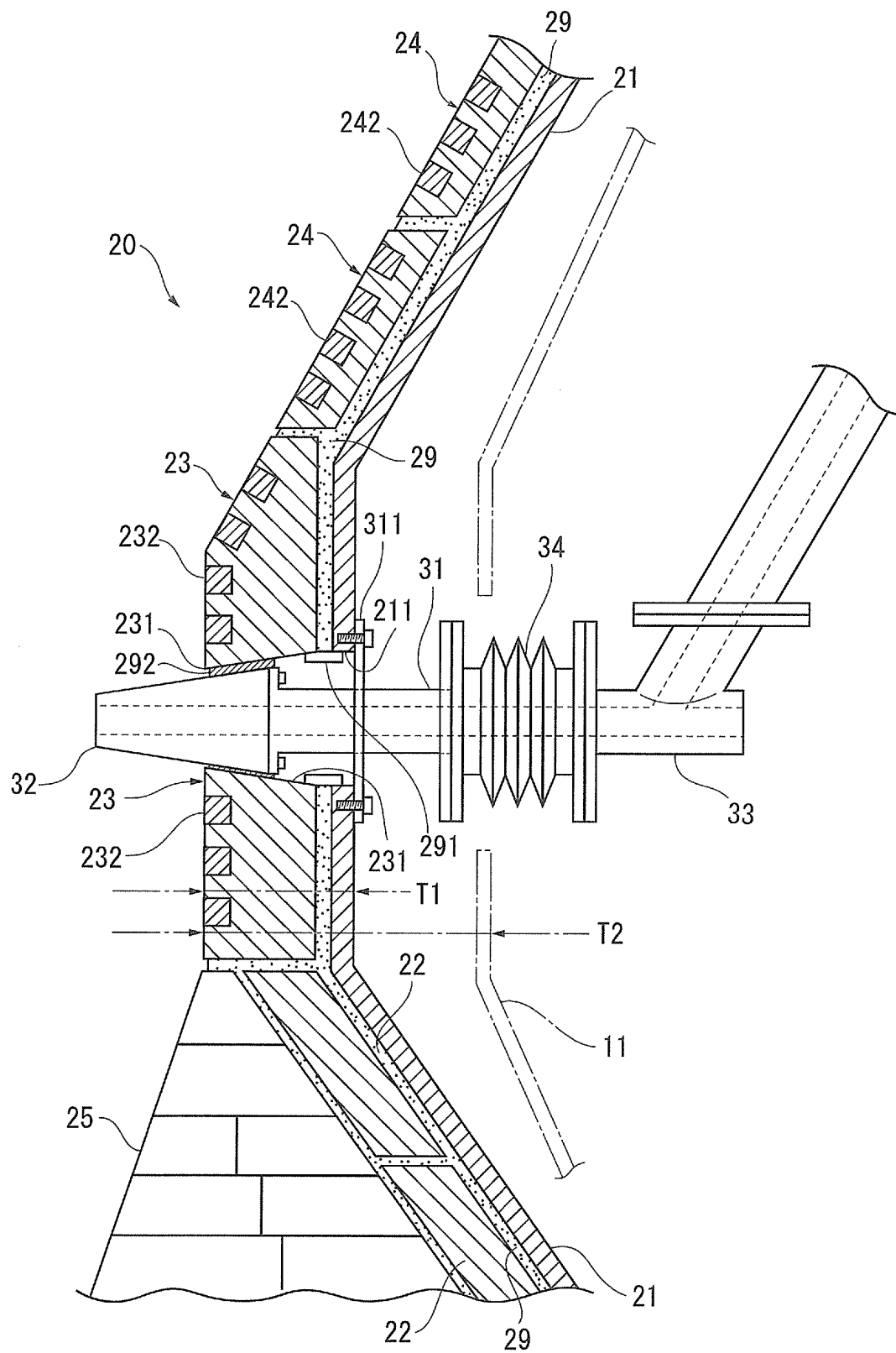


FIG. 2

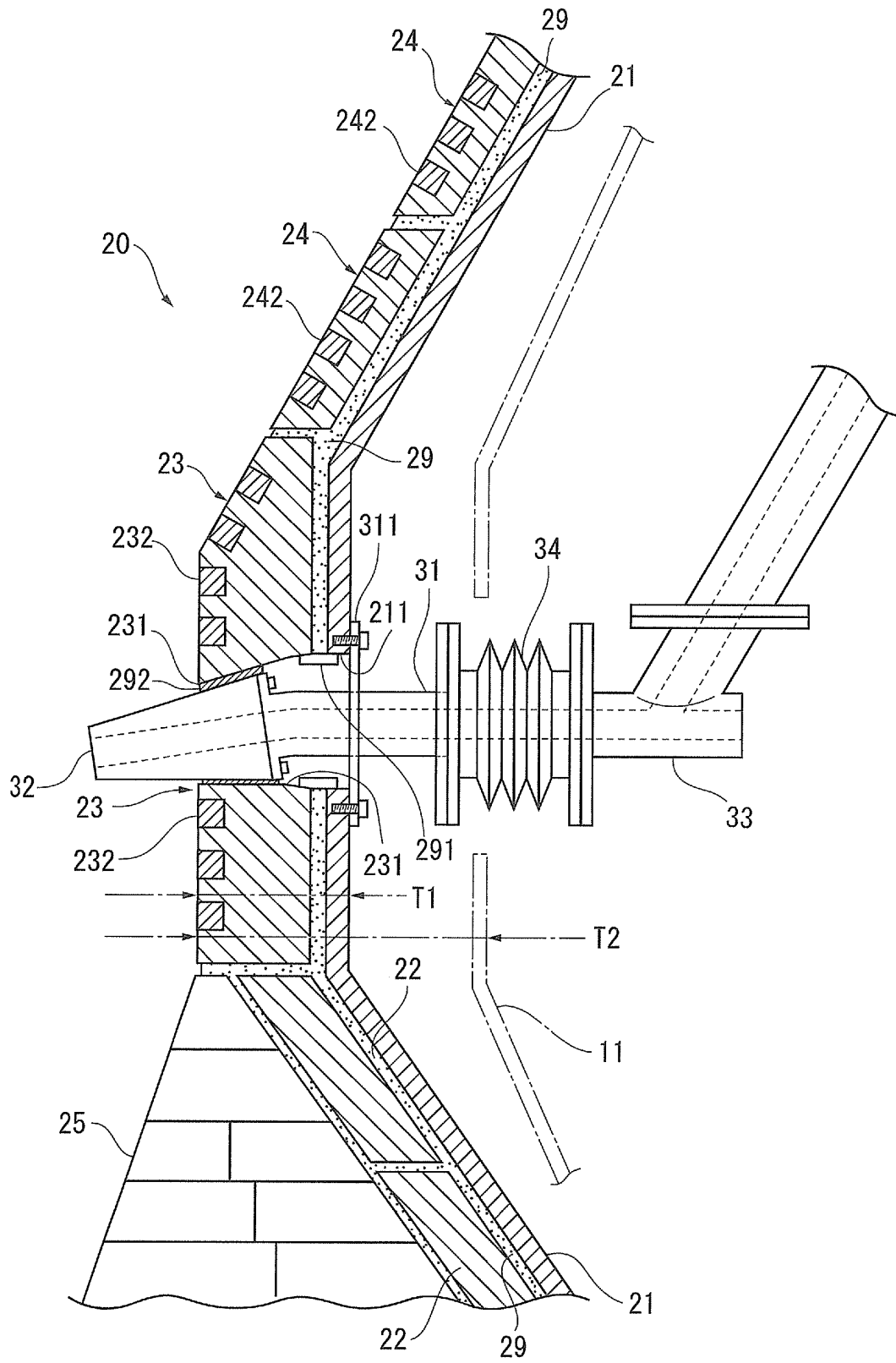
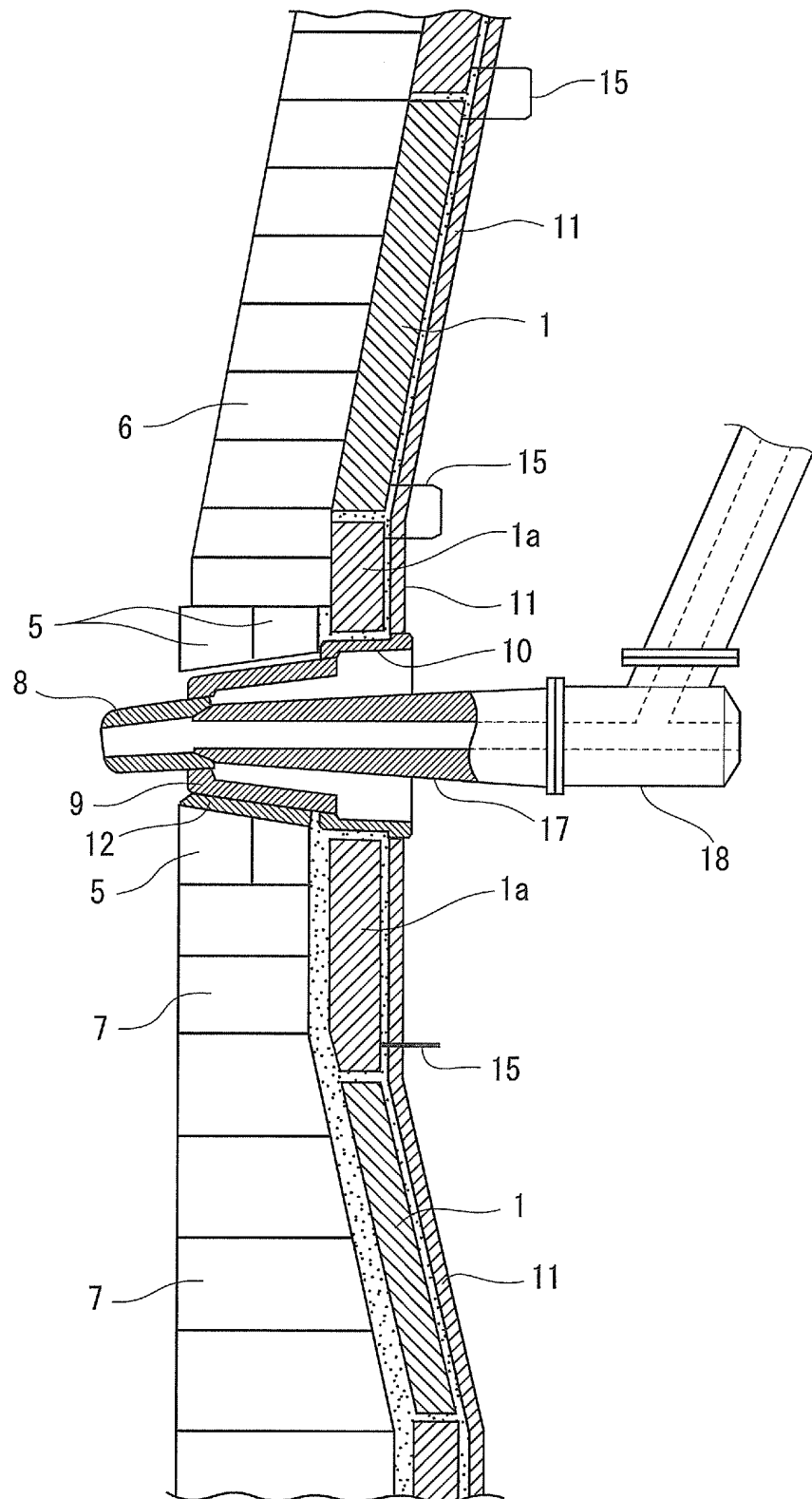


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/063139

A. CLASSIFICATION OF SUBJECT MATTER
C21B7/16(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)
C21B7/16

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 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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 48-30804 Y2 (Ishikawajima-Harima Heavy Industries Co., Ltd.), 20 September 1973 (20.09.1973), fig. 2 (Family: none)	1-3
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 041671/1977 (Laid-open No. 137106/1978) (Kawasaki Steel Corp.), 30 October 1978 (30.10.1978), fig. 1 (Family: none)	1-3

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
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"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	

Date of the actual completion of the international search
12 September, 2013 (12.09.13)

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Authorized officer

Facsimile No.

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Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/063139

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 2-285012 A (Paul Wurth S.A.), 22 November 1990 (22.11.1990), fig. 1 to 3 & GB 2230847 A & GB 8914974 A0 & DE 3920223 A & FR 2646230 A & LU 87504 A	1-3
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 173147/1983 (Laid-open No. 82446/1985) (Kawasaki Steel Corp.), 07 June 1985 (07.06.1985), fig. 1 (Family: none)	1-3
A	JP 2002-220609 A (Nippon Steel Corp.), 09 August 2002 (09.08.2002), entire text (Family: none)	1-3

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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