



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

(43) Date of publication:
18.01.2017 Bulletin 2017/03

(51) Int Cl.:
C21B 9/04 (2006.01) F27D 1/14 (2006.01)

(21) Application number: **15760839.9**

(86) International application number:
PCT/JP2015/057003

(22) Date of filing: **10.03.2015**

(87) International publication number:
WO 2015/137336 (17.09.2015 Gazette 2015/37)

(84) Designated Contracting States:
AL 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 RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

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(30) Priority: **10.03.2014 JP 2014046517**

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(54) **SLOPE BLOCK AND SUPPORT STRUCTURE**

(57) A support structure (32) for supporting checker bricks (5) in a hot-blast stove includes deflecting bricks (7) supporting the checker bricks (5) and support bricks (6) supporting the deflecting bricks (7). The deflecting brick (7) includes a brick body (70) and a deflecting passage (75) connected to through-holes (54) in the checker bricks (5) and opened at an opening section on a side

surface of the brick body (70). The deflecting bricks (7) are arranged along an imaginary deflecting plane that partitions the inside of the hot-blast stove into an upper side and a lower side. A horizontal passages (35) connected to the deflecting passages (75) are defined between the deflecting bricks (7) and the support bricks (6).

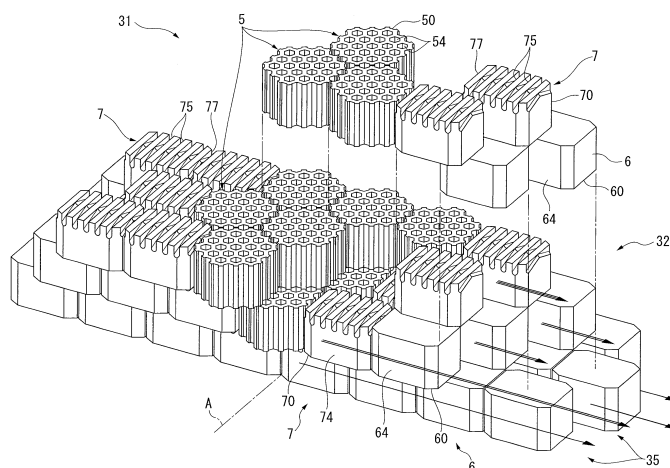


FIG. 4

Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a support structure supporting checker bricks in a hot-blast stove and deflecting blocks used in this support structure.

BACKGROUND ART

10 **[0002]** A hot-blast stove is attached to a pig-iron making blast furnace. Checker bricks are stacked inside the hot-blast stove for storing heat. As a structure for stacking the checker bricks, for instance, the checker bricks are laid so that the individual checker bricks in each course are placed consecutively together to create a stacking structure (flue chimney stack bond pattern; refer to Patent Literature 1). Further, stacking structures are used where the checker bricks in each course are sequentially shifted from those in the adjacent courses in order to avoid aligning joints of the courses (running bond pattern or one-third bond pattern; refer to Patent Literature 2).

15 **[0003]** A duct is connected at a lower side surface of the hot-blast stove to allow air to flow to the checker bricks. A receiving metal supporting the checker bricks is also installed at the bottom surface of the hot-blast stove.

20 **[0004]** A typical receiving metal is a structure in which horizontal steel joists are supported on metal support columns standing on the bottom surface of the hot-blast stove, and a thick metal plate with apertures identical to the through-holes in the checker bricks is fixed on the upper surface of the horizontal joists. The checker bricks are received on an upper surface of the receiving plate. A ventilation space is created underneath the support column between the receiving plate and the support column. The ventilation space is connected to the aforementioned duct.

25 **[0005]** When storing heat in the hot-blast stove, the hot blast heating the checker bricks is injected downwards from the through-holes in the lowest course of the checker bricks to be gathered in the ventilation space, and subsequently is exhausted to the outside from the duct.

30 **[0006]** When supplying a hot blast to the blast furnace, air from outside is introduced into the ventilation space via the duct. From the ventilation space, the air is distributed to the through-holes in the checker bricks. The air is heated during passing through the checker bricks and transmitted to the blast furnace as the hot blast.

35 **[0007]** Incidentally, blast furnace gas (BFG) exhausted from the blast furnace is used as a fuel gas when storing heat in the checker bricks inside the aforementioned hot-blast stove. However, BFG does not provide a sufficient quantity of heat to serve as the sole heat source in the hot-blast stove. Accordingly, the exhaust heat from the hot-blast stove is reused to increase the temperature of (i.e. preheat) the BFG. In addition to using BFG as the fuel gas for the hot-blast stove, coke-oven gas (COG) and Linz-Donawitz converter gas (LDG) and the like are supplementarily mixed in with the BFG to augment the quantity of heat from the fuel.

40 **[0008]** However, since the supplementarily used COG, LDG, and the like are in fact more costly than BFG, it is preferable to avoid using COG, LDG, and the like if possible. Consequently, it is desirable to improve the preheating performance of the BFG.

45 **[0009]** On the other hand, in a blast furnace supplied with a hot blast from the aforementioned hot-blast stove, for instance, at an insufficient temperature or quantity of heat in the hot blast from the hot-blast stove, oxygen is blown into the blast furnace together with the hot blast from the hot-blast stove as needed to augment the quantity of heat from the hot blast.

50 **[0010]** However, blowing oxygen into the blast furnace to supplement the quantity of heat inside the blast furnace increases operational costs in proportion to the amount of oxygen supplied. Preferably, the hot blast provided to the blast furnace from the hot-blast stove is at a sufficiently high temperature to prevent such an increase in operational costs while augmenting the quantity of heat.

55 **[0011]** Examples of a method for blowing oxygen into the blast furnace to supplement the quantity of heat in the blast furnace as previously described include a method in which oxygen is added partway between the hot-blast stove and the blast furnace, and a method in which a preliminarily oxygenated air is supplied in the hot-blast stove. However, when oxygen is added partway between the hot-blast stove and the blast furnace, adding the oxygen reduces the temperature of the hot blast because the oxygen added is not at a high temperature. Accordingly, considering the temperature of the hot blast, the method where the preliminarily oxygenated air is supplied in the hot-blast stove is preferable.

CITATION LIST

60 PATENT LITERATURE(S)

[0012]

Patent Literature 1 Japanese Patent Publication No. 4216777
Patent Literature 2 Japanese Registered Utility Model No. 2563087

SUMMARY OF THE INVENTION

PROBLEM(S) TO BE SOLVED BY THE INVENTION

[0013] As above described, in order to increase the temperature of the hot blast provided from the hot-blast stove to the blast furnace so that the hot blast provides a sufficient quantity of heat, a larger amount of heat must be stored in the checker bricks of the hot-blast stove, and the temperature of the checker bricks, particularly the temperature at the bottom surface must be increased.

[0014] However, the support column and the horizontal joist in the conventional receiving metal are made of steel with a heatproof temperature of roughly 350°C, and so the receiving metal cannot be used in an environment with higher temperatures.

[0015] Given the limitations of the temperature condition for the receiving metal, typical hot-blast stoves have the following defects.

[0016] When supplying a hot blast to the blast furnace, since the temperature of the hot blast used for heating for storing heat in the blast furnace is limited at the receiving metal to 350 degrees C or less, the upper limit of the stored heat energy is limited thereby, and as a result the hot blast supplied to the blast furnace cannot reach a sufficiently high temperature.

[0017] Thus, supplementary oxygen must be blown into the blast furnace, and as a result it is not possible to prevent an increase in the operational costs.

[0018] The temperature of the heating hot blast is limited to about 350 degrees C or less at the receiving metal when storing heat in the hot-blast stove, thereby reducing the temperature of the exhaust heat from the hot-blast stove, so that the BFG cannot be sufficiently preheated.

[0019] Consequently, supplementing the fuel gas of the hot-blast stove with COG or LDG or the like cannot be avoided, and thus it is not possible to reduce a cost for such supplementation.

[0020] The typical receiving metal also presents the following problems.

[0021] The horizontal joist in the receiving metal blocks a part of the through-holes in the checker brick, resulting in losses in a flow efficiency of the hot blast. Specifically, although multiple courses of the checker bricks with the through-holes are laid inside the hot-blast stove, the through-holes penetrate the checker bricks from the top course to the lowest course, so that the hot blast flows through the checker bricks. However, the horizontal joists disposed on the receiving plate block the through-holes in the checker bricks whose planar shapes align with the area where the horizontal joists are installed. Although the horizontal joists block only the through-holes in the checker bricks on the lowest course, the blockage makes it impossible to use the series of through-holes reaching the top course.

[0022] When passing the preliminarily oxygenated air through the hot-blast stove to supplement the quantity of heat, the oxygen blown into the space oxidizes the typical receiving metal. Oxidation of the receiving metal causes breakdown of an inside of the hot-blast stove. In order to avoid the breakdown, it is difficult to pass a highly oxygenated air, especially with a concentration of over 40%, through the hot-blast stove.

[0023] The horizontal joist is also subject to a large bend load in the typical receiving metals. More specifically, the horizontal joist is subject to a continuous bend load under a temperature of roughly 350 degrees C; therefore, a cross-sectional dimension of the horizontal joist must be increased to ensure a sufficiently strong horizontal joist, which further exacerbates the loss at the through-holes in the checker bricks previously described.

[0024] As above described, the temperature condition and the oxygen concentration condition of the typical hot-blast stoves are limited due to the receiving metals, and there is a strong desire to overcome these limitations.

[0025] An object of the invention is to provide a support structure for checker bricks in a hot-blast stove, the support structure capable of eliminating the limitations on the temperature condition and the oxygen concentration condition of the hot-blast stove and improving a use efficiency of the through-holes in the checker bricks; and to provide a deflecting block for use in the support structure.

MEANS FOR SOLVING THE PROBLEM(S)

[0026] According to an aspect of the invention, a deflecting block used in a support structure supporting checker bricks in a hot-blast stove includes: a brick body formed of a refractory material; and a deflecting passage connected to through-holes of the checker bricks and being opened at an opening section on a side surface of the brick body.

[0027] According to this aspect of the invention, the checker bricks are arranged on the upper surface of the brick body to connect the through-holes in the checker brick to the deflecting passage. With this arrangement, the deflecting passage can ensure that the hot blast flows back and forth between the through-holes in the checker bricks and the side

surfaces of the brick body.

[0028] Consequently, when the deflecting block according to the above aspect of the invention is used in the support structure supporting the checker bricks in the hot-blast stove, it is possible to transfer the hot blast from the through-holes in the checker bricks to a duct in the side surface of a bottom in the hot-blast stove, or to transfer air from a duct to the through-holes in the checker bricks.

[0029] Accordingly, the support structure that uses the deflecting block according to the above aspect of the invention may replace the typical receiving metals of the checker bricks.

[0030] Since the brick body of the deflecting block according to the above aspect of the invention is formed from a heat-resistant material (e.g., a refractory brick), the heatproof temperature of the deflecting block can be improved compared to that of the typical steel receiving metal. Accordingly, since there is no need for concern when the deflecting block is used in highly oxygenated atmospheres, higher concentrations of oxygen can be blown into the stove to supplement the quantity of heat. When the deflecting block according to the above aspect of the invention is incorporated as the support structure, the brick body of the deflecting block supports the checker bricks, and thus the deflecting blocks can receive the weight of the checker bricks as a compressive load, not a bend load. Thus, the support structure using the deflecting block according to the above aspect of the invention can sufficiently maintain strength even under high temperatures, and can mitigate the temperature condition better than the typical receiving metals that utilize steel joists.

[0031] The deflecting block according to the above aspect of the invention is structured so that the deflecting passage formed in the brick body is connected to the through-holes in the checker brick, so that the deflecting block can ensure ventilation in all the through-holes in the checker bricks. Accordingly, the support structure using the deflecting blocks according to the above aspect of the invention can effectively use all the through-holes in the checker bricks, and improve the use efficiency of the through-holes without the problem of a part of the through-holes being blocked by a joist as in the typical receiving metals.

[0032] Accordingly, the deflecting block according to the above aspect of the invention can eliminate the limitations on the temperature condition and the oxygen concentration condition for the hot-blast stove and improve the use efficiency of the through-holes.

[0033] In the above arrangement, the brick body is preferably formed of a refractory brick.

[0034] With this arrangement, since a refractory brick is used as the heat-resistant material for the brick body, a high heat resistance can be reliably obtained. Particularly, in addition to a proven performance as the heat resistant material, the refractory brick can facilitate forming the brick body and reduce the production costs.

[0035] Note that a heat-resistant inorganic material such as ceramics may be used as the refractory material. Moreover, without being limited to non-metals, any metal material having heat resistance (i.e., high softening temperature, high melting temperature) may be used.

[0036] In the above arrangement, the deflecting passage is preferably formed in a groove on an upper surface of the brick body.

[0037] With this arrangement, the groove is formed on the upper surface of the brick body with one end of the groove open on a side surface of the brick body, so that the deflecting passage is formed. Such a deflecting passage secures a connection between the through-holes in the checker brick and the side surface of the brick body; at the same time, since the deflecting passage only needs to be formed in a groove in the brick body, the groove can be integrally molded into the brick body as long as the brick body is molded like the brick. Even if the deflecting passage is not integrally molded when molding the brick body, the deflecting passage in a form of a groove can be easily machined in a later stage.

[0038] Note that the deflecting passage may be a duct that opens on the upper surface and the side surface of the brick body and is formed inside the brick body. Alternatively, the deflecting passage may be structured in the above-described groove and partially in a duct. For instance, the duct may be a sloping duct extending from the upper surface of the brick body toward the side surface thereof, or an L-shaped duct opening on the upper surface and the side surface. Also with this arrangement, the deflecting passage also secures a connection between the through-holes in the checker bricks and the side surface of the brick body.

[0039] It is preferable that the deflecting passage has a bottom surface that is slanted downward from a connected portion between the deflecting passage and the through-holes of the checker bricks toward the opening section on the side surface of the brick body.

[0040] With this arrangement, the slanted bottom surface of the deflecting passage changes the direction of the vertical airflow from the through-holes of the checker bricks to the horizontal direction, thereby guiding the airflow to the side surfaces of the brick body. Moreover, a reverse airflow reaching the through-holes from the side surface of the brick body can also be guided in the same manner. Accordingly, in the deflecting block, the deflecting passage can ensure the airflow therethrough and a deflecting function of the airflow.

[0041] Moreover, since the bottom surface is slanted, the flow passage area of the deflecting passage is increased towards the opening section on the side surface, so that, even with a confluence of the airflow from the plurality of through-holes, an increase in the flow rate within the deflecting passage is suppressible and a generated resistance is reducible to a minimum.

[0042] It is preferable that the side surface of the brick body includes opposite first and second side surfaces, the connected portion between the deflecting passage and the through-holes is in a middle of the deflecting passage, and both ends of the deflecting passage are opened on the respective first and second side surfaces.

[0043] With this arrangement, the upper surface of the brick body of the deflecting passage can be connected to the through-holes of the checker brick, and the opening sections on the respective first and second side surfaces of the brick body are connected to space facing the first and second side surfaces. Accordingly, the hot blast from the through-holes in the checker bricks is received at the upper surface of the brick body, passes through the deflecting passage, and is separated and guided towards the first and second side surfaces of the brick body. Moreover, the air supplied to both the sides of the brick body can converge in the deflecting passage, pass over the upper surface of the brick body, and be guided to the through-holes in the checker bricks.

[0044] In the above arrangement, it is preferable that the side surface of the brick body includes opposite first and second side surfaces, the deflecting passage includes a plurality of deflecting passages arranged in parallel, and adjacent ones of the deflecting passages are opened on the respective first and second side surfaces of the brick body.

[0045] With this arrangement, the upper surface of the brick body of the deflecting passage are connected to the through-holes in the checker bricks, and adjacent ones of the deflecting passages are alternately opened on the respective first and second side surfaces of the brick body. Consequently, a part of the through-holes in the checker brick is connected to one side of the brick body while another part of the through-holes in the checker brick is connected to the opposite side of the brick body. Also in this arrangement, the hot blast from the through-holes in the checker brick can be received at the upper surface of the brick body, pass through the deflecting passage, and be separated and guided towards both the sides of the brick body. Moreover, the air supplied to both the sides of the body can converge in the deflecting passage, pass over the upper surface of the body, and be guided to the through-holes in the checker bricks. In this deflecting block, the deflecting passage formed on the upper surface of the brick body is opened only at one side of the brick body. Since it is only required that the deflecting passage is formed to flow the air in one direction (i.e., angled for one-way flow), the production is easy.

[0046] In the above arrangement, it is preferable that the side surface of the brick body includes opposite first and second side surfaces, the deflecting passage includes a plurality of deflecting passages arranged in parallel, and all the the deflecting passages are opened on one of the first and second side surfaces.

[0047] With this arrangement, the deflecting passage are connected to the through-holes in the checker bricks at the upper surface of the brick body, and all the deflecting passages are opened on only one side of the brick body. Therefore, all the through-holes in the checker bricks facing the upper surface of the same deflecting block are connected to the space facing one of the side surfaces of the brick body of the same deflecting block.

[0048] In this deflecting block, since all the deflecting passages formed on the upper surface of the brick body have the same shape (i.e., angled for one-way flow in the same direction), the production is easy. Note that, when adjacent deflecting blocks are alternately oriented in opposite directions, the airflow from the through-holes of the checker bricks can still be alternately separated eventually to both sides of the brick body.

[0049] In the above arrangement, it is preferable that the brick body has a cutout formed by cutting opposite corners of a brick material shaped in a hexagonal prism, and the cutout defines a horizontal passage.

[0050] With this arrangement, the basic shape of the brick body is established with reference to the outline of the hexagonal prism used for the checker brick and a part of the brick body is cut out to form a brick body having a horizontal passage. Consequently, the basic shape of the deflecting block can be established identically as the checker brick, allowing the deflecting block and the checker brick to be assembled together and stacked. For instance, since the respective basic shapes of the deflecting block and the checker brick are in the same hexagonal prism, the deflecting block and checker brick may be mixed together in a running bond pattern.

[0051] Note that the bond pattern of the deflecting block and the checker brick is not limited to the running bond pattern, but other types of bond patterns such as a flue chimney stack bond pattern may be used.

[0052] In the above arrangement, it is preferable that the cutout is formed continuously from the upper surface to a lower surface of the brick body.

[0053] With this arrangement, since the part of the basic hexagonal prism is cut out continuously from the upper surface to the lower surface of the brick body to form the cutout defining the horizontal passage, the shape of the deflecting block can be simplified, thereby facilitating the production.

[0054] In the above arrangement, it is preferable that the cutout is only formed in a part of the brick body between the upper surface and the lower surface of the brick body.

[0055] This arrangement is preferable for using the heat storage function of the deflecting block itself and also allows an uncut part of the brick body to serve as a partition between the horizontal passages arranged in an up-down direction.

[0056] In another aspect of the invention, a support structure supporting checker bricks in a hot-blast stove includes: the deflecting block according to the above aspect of the invention for supporting the checker bricks; and a support member formed of a heat-resistant material and supporting the deflecting block, in which the deflecting block is arranged along an imaginary deflecting plane that partitions an inside of the hot-blast stove into an upper side and a lower side,

and the deflecting block and the support member define the horizontal passage extending horizontally between the deflecting block and the support member and connected to the opening section on the side surface of the deflecting block.

[0057] In the above aspect of the invention, the deflecting block is supported by the support member at the bottom of the hot-blast stove, and the checker bricks are supported on the upper surface of the deflecting block.

[0058] With this arrangement, the opening sections in the side surfaces of the deflecting block are connected to the through-holes in the checker bricks via the deflecting passages. The horizontal passage is formed on the side surface of the deflecting block and passes between the deflecting block and the support member to reach the side surfaces of the bottom in the hot-blast stove. With this arrangement, the through-holes in the checker brick extend from the deflecting passage in the deflecting block through to the horizontal passage to be connected to the space along the side surfaces of the bottom in the hot-blast stove.

[0059] Thus, the support structure according to the above aspect of the invention is capable of ensuring both of the support function of the checker bricks and the ventilation function of the through-holes, thereby replacing the typical receiving member. Using the deflecting block according to the above aspect of the invention as above described can provide heat resistance higher than the typical steel receiving member and resolve the loss of the through-holes due to the support joists.

[0060] Accordingly, the support structure according to the above aspect of the invention can eliminate the limitations on the temperature condition and the oxygen concentration condition for the hot-blast stove and improve the use efficiency of the through-holes.

[0061] In the support structure with the above arrangement, the support member is preferably a support block having the same external dimensions as the deflecting block.

[0062] With this arrangement, since the support block, which serves as the support member, is given the same external dimensions as the deflecting block, the support block and deflecting block may be assembled together and stacked. More specifically, when the basic shape of the deflecting block is in a hexagonal prism identical to that of the checker brick, the basic shape of the support block is also made in the identical hexagonal prism, so that the support member, the deflecting block, and the checker bricks may be mixed together and stacked in a running bond pattern.

[0063] Note that the bond pattern of the support member, the deflecting block and the checker brick is not limited to the running bond pattern, but other types of bond patterns such as a flue chimney stack bond pattern may be used. The bond pattern is desirably selected as appropriate, taking into account the shape of the deflecting plane on which the deflecting blocks are arranged and the arrangement of the horizontal passages.

[0064] In the support structure with the above arrangement, it is preferable that the deflecting block is a deflecting brick formed of a refractory brick, and the support block is a support brick formed of a refractory brick.

[0065] With this arrangement, since the deflecting block and the support block are formed of the refractory brick, a high heat resistance can be reliably obtained. Particularly, in addition to a proven performance as the heat resistant material, the refractory brick can facilitate forming the brick body and reduce the production costs.

[0066] Note that a heat-resistant inorganic material such as ceramics may be used as the refractory material. Moreover, without being limited to non-metals, any metal material (e.g., cast iron) having heat resistance (i.e., high softening temperature, high melting temperature) and oxidation resistance (i.e., when blow-in oxygen is at a high concentration) may be used.

[0067] In the support structure with the above arrangement, the support member is preferably a support column formed of a refractory brick and supporting the deflecting block.

[0068] With this arrangement, since the support column is used as the support member, the number of the support member arranged in a height direction is reducible. Additionally, a space between adjacent support columns may be used to form the horizontal passages. Further, the spaces between adjacent support columns may be collectively connected by the deflecting passages in a plurality of deflecting blocks to create a massive confluence space, and connect the confluence space to a duct on the side surface of the hot-blast stove.

[0069] In the support structure with the above arrangement, the support column is preferably in a form of a plurality of support column components connected together lengthwise.

[0070] With this arrangement, it is possible to limit the length of each of the support column members even when the support column is used as the support member, which is preferable in terms of production and transportation.

[0071] In the support structure with the above arrangement, the deflecting plane is preferably formed in a V-shape extending diagonally upward and away from a reference axis that traverses a bottom surface of the hot-blast stove.

[0072] With this arrangement, by arranging the deflecting blocks along a V-shaped deflecting plane, the through-holes in the checker bricks supported on the upper surface of the deflecting blocks are connected to the horizontal passages extending through the deflecting blocks and the support members.

[0073] In this arrangement, the slanted deflecting plane ensures that a specific region inside the hot-blast stove in a plan view corresponds to a specific region in the height direction of the side surface of the hot-blast stove through the deflecting plane. Accordingly, the flow rate distribution may be suitably adjusted by allocating the through-holes of the checker bricks in each of the regions to the horizontal passage corresponding to each height.

[0074] Additionally, since the deflecting plane is provided in a V shape by two facing slanted surfaces, the deflecting blocks arranged along the deflecting plane are oriented in the same direction. The horizontal passages extend away from the reference axis in a direction intersecting with the reference axis. Accordingly, the horizontal passages are parallel to each other, thereby facilitating designing the arrangement of the horizontal passages in the support structure.

[0075] In the support structure with the above arrangement, it is preferable that the deflecting plane is formed substantially in a cone or substantially in a pyramid extending diagonally upward toward a periphery of the hot-blast stove from a bottom surface thereof.

[0076] With this arrangement, arranging the deflecting blocks into a substantially cone-shaped or a substantially pyramid-shaped deflecting plane connects the through-holes in the checker bricks supported on the upper surface of the deflecting blocks to the horizontal passages extending through the deflecting blocks and the support members.

[0077] In this arrangement, the slanted deflecting plane ensures that a specific region inside the hot-blast stove in a plan view corresponds to a specific region in the height direction of the side surface of the hot-blast stove through the deflecting plane. Accordingly, the flow rate distribution may be suitably adjusted by allocating the through-holes of the checker bricks in each of the regions to the horizontal passage corresponding to each height.

[0078] Since the deflecting plane is substantially cone-shaped or substantially pyramid-shaped, the deflecting blocks are circularly aligned around the center axis line of the substantially cone-shaped or substantially pyramid-shaped deflecting plane and the horizontal passages are radially formed around the center axis line of the substantially cone-shaped or substantially pyramid-shaped deflecting plane. Accordingly, the horizontal passages extending toward the periphery of the hot-blast stove can be assumed to be uniform along the radial direction. More specifically, when the deflecting block is a hexagonal prism, the deflecting plane can be assumed to be a hexagonal pyramid or a triangular pyramid; thus, arranging the horizontal passages in a direction intersecting with edges of the bottom surface allows the horizontal passages to be uniform in the radial direction while simplifying the structure.

[0079] In the support structure with the above arrangement, it is preferable that the deflecting plane extends horizontally.

[0080] With this arrangement, arranging the deflecting blocks along the horizontally extending deflecting plane connects the through-holes in the checker bricks supported on the upper surface of the deflecting blocks to the horizontal passages facing the side surfaces of the deflecting blocks. Moreover, since the confluence space is created underneath the horizontally extending deflecting plane and the horizontal passages facing the deflecting blocks are connected, all the through-holes of the checker bricks supported on the deflecting blocks are connected to the confluence space. This confluence space can be defined by the above-mentioned structure using the above-described support column.

[0081] With this arrangement, the checker bricks can be supported, the through-holes can be connected without loss, and the structure can be simplified with a simple deflecting plane.

[0082] According to the support structure for the checker bricks in the hot-blast stove and the deflecting block used for the support structure in the above aspect of the invention, the limitations on the temperature condition and the oxygen concentration condition can be eliminated and the use efficiency of the through-holes can be improved.

BRIEF DESCRIPTION OF DRAWING(S)

[0083]

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

Fig. 2 is an enlarged cross-sectional view of a bottom of a hot-blast stove in the first exemplary embodiment.

Fig. 3 is a schematic view of a deflecting surface in the first exemplary embodiment.

Fig. 4 is an exploded perspective view of a brick stack structure in the first exemplary embodiment.

Fig. 5 is a perspective view of a checker brick in the first exemplary embodiment.

Fig. 6 is a schematic view of a deflecting brick in the first exemplary embodiment.

Fig. 7 is a perspective view of a support brick in the first exemplary embodiment.

Fig. 8 is a horizontally cross-sectional view of the bottom of the hot-blast stove in the first exemplary embodiment.

Fig. 9 is a cross-sectional view showing an entirety in a second exemplary embodiment of the invention.

Fig. 10 is a horizontally cross-sectional view of a bottom of a hot-blast stove in the second exemplary embodiment.

Fig. 11 is an exploded perspective view of a brick stack structure in a third exemplary embodiment of the invention.

Fig. 12 is a perspective view of an upper support brick in the third exemplary embodiment.

Fig. 13 is a perspective view of a lower support brick in the third exemplary embodiment.

Fig. 14 is a perspective view of a deflecting brick in the third exemplary embodiment.

Fig. 15 is an enlarged cross-sectional view showing a bottom of a hot-blast stove in a fourth exemplary embodiment of the invention.

Fig. 16 is an exploded perspective view of a brick stack structure in the fourth exemplary embodiment.

Fig. 17 is a perspective view of a support member in the fourth exemplary embodiment.

Fig. 18 is a perspective view of a deflecting brick in the fourth exemplary embodiment.

Fig. 19 is a perspective view of a flow rate adjustment checker brick in the fourth exemplary embodiment.
 Fig. 20 is an exploded perspective view of a brick stack structure in a fifth exemplary embodiment of the invention.
 Fig. 21 is a perspective view of an abutting member in the fifth exemplary embodiment.
 Fig. 22 is a perspective view showing a modification of the deflecting brick of the invention.
 Fig. 23 is a perspective view showing a modification of the support brick of the invention.
 Fig. 24 is a perspective view showing another modification of the support brick of the invention.
 Fig. 25 is a perspective view showing another modification of the deflecting brick of the invention.
 Fig. 26 is a perspective view showing still another modification of the deflecting brick of the invention.
 Fig. 27 is a perspective view showing a further modification of the deflecting brick of the invention.
 Fig. 28 is an exploded perspective view of a brick stack structure in a sixth exemplary embodiment of the invention.
 Fig. 29 is a cross-sectional view showing an entirety in a seventh exemplary embodiment of the invention.
 Fig. 30 is a horizontally cross-sectional view in the seventh exemplary embodiment.

DESCRIPTION OF EMBODIMENT(S)

First Exemplary Embodiment

[0084] Figs. 1 to 8 show a first exemplary embodiment of the invention.

[0085] In Fig. 1, a hot-blast stove 1 of the first exemplary embodiment is an external hot-blast stove including a combustion chamber 2, a checker chamber 3, and a connecting pipe 4 connecting respective top portions of the combustion chamber 2 and the checker chamber 3.

[0086] The combustion chamber 2 includes a cylindrical furnace shell 20.

[0087] A heating burner 21 is installed in the combustion chamber 2 at a bottom of the furnace shell 20. A fuel gas supply pipe 22 and an outer-air supply pipe 23 are connected to a side surface at the bottom of the furnace shell 20. The burner 21 mixes the fuel gas and the outer air respectively supplied from the fuel gas supply pipe 22 and the outer-air supply pipe 23 to ignite, thereby generating high-temperature combustion gas. The generated high-temperature combustion gas passes through the connecting pipe 4 to be supplied to the checker chamber 3.

[0088] A hot-blast supply pipe 24 is connected to the side surface of the furnace shell 20 above the burner 21 in the combustion chamber 2. The hot-blast supply pipe 24 is connected to the tuyere (not shown) of a blast furnace, allowing a hot blast transmitted from the checker chamber 3 through the connecting pipe 4 and the inside of the combustion chamber 2 to be supplied to the blast furnace.

[0089] The checker chamber 3 includes a cylindrical furnace shell 30.

[0090] A heat storage 31 is built inside the furnace shell 30 of the checker chamber 3 formed by stacking a plurality of checker bricks 5. The checker bricks 5 are described in detail below; the checker bricks 5 are stacked so that the through-holes formed in each of the checker bricks 5 continue from the upper surface to the lower surface of the heat storage 31, allowing ventilation between the bottom and the top of the bottom of the checker chamber 3 via the through-holes.

[0091] A support structure 32 according to the exemplary embodiment is arranged at the bottom of the furnace shell 30 in the checker chamber 3 in order to support the heat storage 31. A cylindrical ventilation space 33 is formed surrounding the support structure 32 between the support structure 32 and the furnace shell 30, with a ventilation pipe 34 formed in the side surface of the furnace shell 30 connected to the ventilation space 33.

[0092] As illustrated in Fig. 2, the bottom surface of the checker chamber 3 is lined with foundation bricks 39, and the support structure 32 supports support bricks 6, which are support blocks, laid on top of the foundation bricks 39 and deflecting bricks 7 (shown by black rectangles in Fig. 2), which are deflecting blocks according to the exemplary embodiment, laid on the support bricks 6.

[0093] The support bricks 6 and the deflecting bricks 7 are described in detail later. Each of the deflecting bricks 7 connects the through-holes in the above-described checker brick 5 and the ventilation space 33, allowing mutual airflow therethrough.

[0094] The support bricks 6 and the foundation bricks 39 interlock (e.g., the convex part on the upper surface of the foundation brick 39 may fit into the concave part in the lower surface of the support brick 6) to prevent displacement thereof in the horizontal direction.

[0095] In the support structure 32 according to the exemplary embodiment, the deflecting bricks 7 are arranged along an imaginary V-shaped deflecting plane S1, S2. In order to support the deflecting bricks 7 so that the deflecting bricks 7 form the above described arrangement, the support bricks 6 are stacked with the upper surfaces aligned along below the deflecting plane S1, S2.

[0096] As illustrated in Fig. 3, the deflecting plane S1, S2 of the exemplary embodiment are each half circular imaginary planes that are slanted upward in a manner to separate from each other relative to a reference axis A. The reference axis A is, for instance, any diameter of the bottom in the checker chamber 3.

[0097] In the deflecting bricks 7 arranged along the deflecting plane S1, S2 in this manner, for instance, a vertically moving gas Gv traveling through the heat storage 31 (i.e., passing through the through-holes in the above-described checker bricks 5) is deflected at the deflecting plane S1, S2 along which the deflecting bricks 7 are arranged, and guided as a gas Gh moving in an intersectional direction with the reference axis A and in the horizontal direction to the ventilation space 33 (Fig. 2) surrounding the support structure 32.

[0098] The above-mentioned checker bricks 5, the support bricks 6, the deflecting bricks 7, as well as the support structure 32 provided thereby are described below.

[0099] Figs. 4 and 5 show the checker bricks 5 of the exemplary embodiment.

[0100] As can be seen from Fig. 5, each of the checker bricks 5 includes a brick body 50 molded from a refractory brick material.

[0101] The brick body 50 is given a basic shape 5P of a hexagonal prism provided with an upper surface 51 and a lower surface 52 being hexagons, and six side surfaces 53 connecting the upper and lower surfaces.

[0102] The brick body 50 includes hexagonal cylindrical through-holes 54 opened in the upper surface 51 and the lower surface 52 thereof.

[0103] Grooves 55 formed by bisecting the through-holes 54 are formed on the side surface 53. A groove 56 shaped as one third of the through-hole 54 is formed at the point where the angled corners of two side surfaces 53 come together.

[0104] As for the grooves 55, 56, when stacking the checker bricks 5, the side surfaces 53 on two brick bodies 50 are brought together facing each other, so that two of the grooves 55 define a space corresponding to a single through-hole 54. Moreover, by collecting the corners of three brick bodies 50, three grooves 56 define a space corresponding to a single through-hole 54.

[0105] The above-described checker bricks 5 are arranged in a running bond pattern inside the checker chamber 3 to define the heat storage 31.

[0106] As illustrated in Fig. 4, when the checker bricks 5 are stacked in running bond pattern, each of the corners is arranged at the center of the checker bricks 5 stacked above and below. The space defined by the grooves 55, 56, which correspond to the through-hole 54 is connected to the through-hole 54 of the checker bricks 5 stacked above and below.

[0107] Accordingly, a ventilation passage is formed across the entire horizontal surface in the heat storage 31 illustrated in Figs. 1 and 2, passing through from the upper surface to the lower surface of the heat storage 31, thereby allowing maximum flow of the vertically moving gas Gv illustrated in Fig. 2.

[0108] Note that other than the running bond pattern, the checker bricks 5 in the heat storage 31 may be stacked in a flue chimney stack bond pattern (see the sixth exemplary embodiment, Fig. 28).

[0109] Figs. 4 and 6 show the support bricks 6 of the exemplary embodiment.

[0110] As can be seen from Fig. 6, each of the support bricks 6 includes a brick body 60 molded from a refractory brick material.

[0111] Although the basic shape 6P of the brick body 60 is a hexagonal prism, a pair of opposite corners is cut to form a substantially rectangular body. Specifically the brick body 60 includes an upper surface 61, a lower surface 62, side surfaces 63 that correspond to side surfaces of the basic shape 6P, and auxiliary side surfaces 64 formed by cutting the opposite corners.

[0112] Note that the basic shape 6P is identical to the basic shape 5P of the checker brick 5 (see Fig. 5), allowing the support brick and the checker brick to be assembled together and stacked in a running bond pattern.

[0113] Figs. 4 and 7 illustrate the deflecting bricks 7 of the exemplary embodiment.

[0114] As can be seen from Fig. 7, each of the deflecting bricks 7 includes a brick body 70 molded from a refractory brick material.

[0115] Although the basic shape 7P of the brick body 70 is a hexagonal prism, a pair of opposite corners is cut to form a substantially rectangular body in the same manner as in the support bricks 6 (see Fig. 6). Specifically the brick body 70 includes an upper surface 71, a lower surface 72, side surfaces 73 that correspond to side surfaces of the basic shape 7P, and auxiliary side surfaces 74 formed by cutting the opposite corners.

[0116] Note that the basic shape 7P is identical to the basic shape 5P of the checker brick 5 (see Fig. 5) and the basic shape 6P of the support brick 6 (see Fig. 6), allowing the support brick and the checker brick to be assembled together and stacked in a running bond pattern.

[0117] Deflecting passages 75 each shaped in a groove are formed in the deflecting brick 7 extending from the upper surface 71 to the side surface 73 and the auxiliary side surface 74.

[0118] A plurality of deflecting passages 75 are formed parallel to the side surface 73 where the auxiliary side surface 74 is not formed (i.e., the deflecting passages 75 are orthogonal to the auxiliary side surface 74) traversing the upper surface 71 with both ends thereof opened on the side surface 73 or the auxiliary side surface 74.

[0119] A deflecting passage 77 which is a bisected version of the above-described deflecting passage 75 is formed on an edge connecting the side surfaces 73 where neither the upper surface 71 nor the auxiliary side surface 74 are formed.

[0120] The deflecting passage 77 defines a groove identical to that of the deflecting passage 75 when two deflecting

bricks 7 are connected together.

[0121] The bottom surfaces 76 of the deflecting passages 75, 77 are shaped in a mountain and slant from the center downward toward each end.

[0122] The deflecting passages 75, 77 are arranged so that, when stacked together with the checker bricks 5 in a running bond pattern as illustrated in Fig. 4, all the through-holes 54 in the checker bricks 5 in the upper course are connected to any of the deflecting passages 75, 77.

[0123] The above described support bricks 6 and deflecting bricks 7 are stacked on the bottom of the checker chamber 3 in a running bond pattern based on each of the basic shapes 6P, 7P, thereby forming the support structure 32.

[0124] Furthermore, a horizontal passage 35 of the exemplary embodiment extending in an orthogonal direction to the reference axis A is formed between the support bricks 6 and the deflecting bricks 7 stacked in a running bond pattern as the support structure 32.

[0125] The support structure 32 is built in the following manner.

[0126] As shown in Fig. 4, the lowest course of the support structure 32 is established on the bottom of the checker chamber 3. In the lowest course, one or two deflecting bricks 7 are arranged along the reference axis A, and the support bricks 6 are arranged on both sides in order (in a direction intersecting with the reference axis A). The support bricks 6 are arranged consecutively orthogonal to the reference axis A with the side surfaces 63 where there are no auxiliary side surfaces 64 close together.

[0127] The auxiliary side surfaces 64, 74 are continuous to each other in a row of the deflecting bricks 7 and the support bricks 6 arranged in this manner. With the auxiliary side surfaces 64, 74 in an adjacent row of the deflecting bricks 7 and the support bricks 6, a gap is formed. The gap defines the horizontal passage 35 extending orthogonal to the reference axis A.

[0128] As a second course, the checker bricks 5, the deflecting bricks 7, and the support bricks 6 are arranged on top of the support bricks 6 in the above-mentioned lowest course in order from the reference axis A outward along the intersecting direction.

[0129] The second course of the checker bricks 5 forms the heat storage 31 as above described, and is arranged on the lowest course of the deflecting bricks 7.

[0130] The second course of the deflecting bricks 7 is arranged outside the checker bricks 5 and supported on the lowest course of the support bricks 6.

[0131] The second course of the support bricks 6 is arranged outside the deflecting bricks 7 and supported on the lowest course of the support bricks 6.

[0132] Further, a third course is arranged on the second course in the same manner so that the deflecting bricks 7 in the lower course are always directly beneath the checker brick 5 in the upper course. Herein, all the through-holes 54 in the checker bricks 5 in the upper course are connected to the deflecting passages 75, 77 in the deflecting bricks 7 in the lower course, so that the through-holes 54 are connected to the horizontal passages 35 between the deflecting bricks 7 and the support bricks 6 in the lower course via the deflecting passages 75, 77.

[0133] Note that, in Fig. 4, the horizontal passages 35 in each of the courses are indicated by arrows; the horizontal passages 35 in the lowest course are indicated by a single line arrow, the horizontal passages 35 in the second course are indicated by a double line arrow, and the horizontal passages 35 in the third course are indicated by a triple line arrow.

[0134] Thus, the checker bricks 5, the deflecting bricks 7, and the support bricks 6 are stacked in order away from the reference axis A in a direction orthogonal thereto in each course, and each lower course is stacked in a running bond pattern, whereby the lower part of the support structure 32 and heat storage 31 are sequentially built.

[0135] In this support structure 32, the deflecting bricks 7 are arranged separating from the reference axis A as the number of courses increases, and as a result the deflecting bricks 7 are arranged along the deflecting plane S1, S2 (Figs. 2 and 3) which are in a V-shape extending away from the reference axis A.

[0136] As illustrated in Fig. 8, the horizontal passages 35 formed between the deflecting bricks 7 and the support bricks 6 are arranged in a direction intersecting the reference axis A in any course of the support structure 32 that includes the V-shaped deflecting plane S1, S2.

[0137] The checker bricks 5 forming the lower part of the heat storage 31 are arranged in a region Rv along the reference axis A. The through-holes 54 in the checker bricks 5 in the region Rv allow airflow of a vertically moving gas Gv (see Figs. 2 and 3).

[0138] The deflecting bricks 7 are arranged in a region Rt outside the region Rv (i.e., away from the reference axis A). In the region Rt, the gas Gv from the through-holes 54 in the checker bricks 5 in the upper course is guided via the deflecting passages 75, 77 to the horizontal passages 35 facing the auxiliary side surfaces 74 and is deflected horizontally to define the gas Gh.

[0139] The support bricks 6 are arranged in a region Rh outside the region Rt. In the region Rh, the horizontal passages 35 formed between the deflecting bricks 7 in the region Rt are connected to the horizontal passages 35 between the auxiliary side surfaces 64 in the continuous support bricks 6. The horizontal passages 35 between the support bricks 6 lead to the outside of the support structure 32 and is connected to the ventilation space 33 surrounding the support

structure 32 through to the ventilation pipe 34.

[0140] Consequently, the deflecting passages 75, 77 in the deflecting bricks 7 in the support structure 32 according to the exemplary embodiment allow the vertically moving gas Gv to change the direction and be extracted via the horizontal passages 35 as the horizontally moving gas Gh (or allow flow in the reverse direction).

[0141] According to the above exemplary embodiment, the following advantages can be obtained.

[0142] The checker bricks 5 are arranged on the upper surface of the brick body 70 of the deflecting bricks 7 assembled into the support structure 32, and the through-holes 54 in the checker bricks 5 are connected to the deflecting passages 75, 77, so that the through-holes 54 and the horizontal passages 35 are connected to each other via the deflecting passages 75, 77, which ensures mutual flow of the hot blast therethrough.

[0143] Thus, the vertically moving gas Gv from the through-holes 54 in the checker bricks 5 can change direction to be discharged to the ventilation space 33 and the ventilation pipe 34 as the horizontally moving gas Gh.

[0144] Airflow in the reverse direction is also possible. Specifically, air from the ventilation pipe 34 may be taken in from the horizontal passages 35 into the deflecting bricks 7, made to change direction by the deflecting passages 75, 77 and discharged into the through-holes 54 in the checker bricks 5.

[0145] Accordingly, the support structure 32 using the deflecting bricks 7 and the support bricks 6 according to the embodiment can replace the typical receiving metals used for the checker bricks.

[0146] In the exemplary embodiment, the support structure 32 can be structured including the deflecting bricks 7 serving as the deflecting blocks and the support bricks 6 serving as the support members.

[0147] Since the respective brick bodies 60 and 70 of the deflecting bricks 7 and the support bricks 6 are formed of a refractory brick (heat-resistant material), the heatproof temperature can be improved compared to the typical steel receiving metals.

[0148] Particularly, in addition to a proven performance as the heat resistant material, the refractory brick can facilitate forming the brick bodies 60 and 70 and reduce the production costs.

[0149] When the deflecting bricks 7 and the support bricks 6 are incorporated as the support structure 32, the brick body 70 can support the checker bricks 5 and the brick body 60 can support the deflecting bricks 7, so that the deflecting bricks 7 and the support bricks 6 can receive a compressive load, not a bend load.

[0150] Thus, the support structure 32 using the deflecting bricks 7 and the support bricks 6 can sufficiently maintain strength even under high temperatures, and can mitigate the temperature condition better than the typical receiving metals that utilize steel joists.

[0151] Further, each of the deflecting bricks 7 in the exemplary embodiment is structured so that the deflecting passages 75, 77 formed in the brick body 70 are connected to the through-holes 54 in the checker bricks 5, whereby the deflecting bricks 7 can ensure ventilation in all the through-holes 54 in the checker bricks 5.

[0152] Accordingly, the support structure 32 using the deflecting bricks 7 in the exemplary embodiment can effectively use all the through-holes 54 in the checker bricks 5, and improve the use efficiency of the through-holes 54 without the problem of a part of the through-holes 54 of the checker bricks 5 being blocked by a joist as in the typical receiving metals.

[0153] As above described, in the exemplary embodiment, by using a support structure 32 including the deflecting bricks 7 and the support bricks 6 according to the invention, it is possible to eliminate the limitations on the temperature condition caused by the support structure supporting the checker bricks 5 in the hot-blast stove 1 and to improve the use efficiency of the through-holes.

[0154] In the exemplary embodiment, the groove is formed on the upper surface 71 of the brick body 70 of the deflecting brick 7 with one end of the groove open on the side surface 73 or the auxiliary side surface 74 of the brick body 70, so that the deflecting passages 75, 77 are formed.

[0155] The deflecting passages 75, 77 secure a connection between the through-holes 54 in the checker brick 5 and the side surface 73 or the auxiliary side surface 74 of the brick body 70; at the same time, since the deflecting passages 75, 77 only need to be formed in a groove in the brick body 70, the groove can be integrally molded into the brick body 70 as long as the brick body 70 is molded like the brick. Even if the deflecting passage is not integrally molded when molding the brick body, the deflecting passage in a form of a groove can be easily machined in a later stage.

[0156] In the exemplary embodiment, with the slanted bottom surface 76 of the deflecting passages 75, 77, the vertically moving gas Gv from the through-holes 54 in the checker bricks 5 can change direction to be guided to the horizontal passage 35 facing the side surface 73 or the auxiliary side surface 74 of the brick body 70 as the horizontally moving gas Gh. Moreover, a reverse airflow reaching the through-holes 54 from the horizontal passage 35 through the deflecting passages 75, 77 can also be guided in the same manner. Accordingly, in the deflecting block, the deflecting passage can ensure the airflow therethrough and a deflecting function of the airflow.

[0157] Moreover, since the bottom surface 76 is slanted, the flow passage area of the deflecting passages 75, 77 is increased towards the opening on the side surface 73 or the auxiliary side surface 74, so that, even with a confluence of the airflow from the plurality of through-holes 54, an increase in the flow rate within the deflecting passage is suppressible and a generated resistance is reducible to a minimum.

[0158] Since the deflecting passages 75, 77 in the exemplary embodiment are opened on the side surface 73 or the

auxiliary side surface 74 on both sides of the brick body 70 and include a slanted bottom surface 76 having a projecting center like a mountain, the brick body 70 receives the vertically moving gas Gv from the through-holes 54 in the checker bricks 5 at the upper surface 71 thereof, the vertically moving gas Gv passes through the deflecting passages 75, 77 and is split between the horizontal passages 35 on both sides of the brick body 70 to be guided as the horizontally moving gas Gh. Moreover, in reverse, the air supplied to the horizontal passages 35 on both the sides of the brick body 70 can converge in the deflecting passages 75, 77, pass over the upper surface 71 of the brick body 70, and be guided to the through-holes 54 in the checker bricks 5.

[0159] In the exemplary embodiment, since the checker bricks 5, the support bricks 6, and the deflecting bricks 7 respectively have the basic shapes 5P, 6P and 7P in a hexagonal prism in common, the checker bricks 5, the support bricks 6, and the deflecting bricks 7 can be built in combination in a running bond pattern.

[0160] Moreover, since the auxiliary sides surfaces 64, 74 are formed on the support bricks 6 and the deflecting bricks 7 by cutting out opposite corners of the brick bodies 60, 70 shaped in a hexagonal prism, the auxiliary side surfaces 64, 74 can form the horizontal passages 35 while using the common basic shapes 6P, 7P.

[0161] In the exemplary embodiment, when forming the horizontal passages 35 along the respective side surfaces of the support bricks 6 and the deflecting bricks 7, the opposite corners in the brick bodies 60, 70 shaped in a hexagonal prism are continuously cut out from the upper surfaces 61, 71 to the lower surfaces 62, 72, thereby forming the auxiliary side surfaces 64, 74. Since the horizontal passages 35 is formed by the above continuous cutout from the upper surfaces 61, 71 to the lower surfaces 62, 72, the shape of the bricks can be simplified, thereby facilitating the production.

[0162] In the exemplary embodiment, in the support structure 32, a V-shaped deflecting plane S1, S2 is formed expanding diagonally upward away from the reference axis A that traverses the bottom surface of the checker chamber 3. By arranging the deflecting brick 7 along the V-shaped deflecting plane S1, S2, the through-holes 54 in the checker bricks 5 supported on the upper surface of the deflecting brick 7 can be connected to the horizontal passages 35 extending through the deflecting bricks 7 and the support bricks 6 through the deflecting passages 75, 77.

[0163] In this arrangement, the slanted deflecting plane S1, S2 ensures that a specific region (i.e., the region Rt where the deflecting bricks 7 are placed) inside the checker chamber 3 in a plan view corresponds to a specific region in the height direction of the ventilation space 33 surrounding the bottom of the checker chamber 3 through the deflecting plane S1, S2. Accordingly, the flow rate distribution may be suitably adjusted by allocating the through-holes 54 of the checker bricks 5 facing the region Rt in each of the courses of the support structure 32 to the horizontal passage 35 corresponding to each height.

[0164] Additionally, since the deflecting plane S1, S2 is provided in a V shape by two facing slanted surfaces, the deflecting bricks 7 arranged along the deflecting plane S1, S2 are oriented in the same direction. The horizontal passages 35 extend away from the reference axis A in a direction intersecting with the reference axis A. Accordingly, the horizontal passages 35 are parallel to each other, thereby facilitating designing the arrangement of the horizontal passages 35 in the support structure 32.

Second Exemplary Embodiment

[0165] Figs. 9 to 10 show a second exemplary embodiment of the invention.

[0166] Although the V-shaped deflecting plane S1, S2 is defined in the first exemplary embodiment, a substantially cone-shaped deflecting plane S3 is used in the second exemplary embodiment.

[0167] Note that, compared to the previously described first exemplary embodiment, the deflecting plane S3 in the second exemplary embodiment is in a different shape, whereby the arrangement of the deflecting bricks 7, the support bricks 6, and the checker bricks 5 are different in the support structure 32. However, in the second exemplary embodiment the structure of the hot-blast stove 1, the structure of the heat storage 31 and the support structure 32, and the structure of the deflecting bricks 7, the support bricks 6, and the checker bricks 5 are identical to those in the first exemplary embodiment.

[0168] Accordingly, in the following description, only the parts that differ from the previously described first embodiment are described.

[0169] As illustrated in Fig. 9, the imaginary deflecting plane S3 in the second exemplary embodiment is an inverted cone where the apex is at the center of the bottom surface of the furnace shell 30 in the checker chamber 3.

[0170] In the support structure 32 in the second exemplary embodiment, the deflecting bricks 7 are arranged along the substantially cone-shaped deflecting plane S3. The vertically moving gas Gv from the heat storage 31 changes direction at the deflecting bricks 7 and is discharged as the horizontally moving gas Gh.

[0171] In the support structure 32 in the second exemplary embodiment, the horizontal passages 35 are arranged radiating from the center of the deflecting plane S3. The horizontally moving gas Gh from the deflecting bricks 7 is discharged radially from the horizontal passages 35 from the center of the deflecting plane S3.

[0172] In the second exemplary embodiment, for instance, when the same hexagonal prism is used as the respective basic shapes 7P, 6P, 5P of the deflecting bricks 7, the support bricks 6, and the checker bricks 5, the substantially cone-

shaped deflecting plane S3 is desirably in a hexagonal pyramid or a triangular pyramid corresponding to the hexagon depending on the basic shapes.

[0173] As illustrated in Fig. 10, in any course in the support structure 32, the checker bricks 5 forming the lower part of the heat storage 31 are placed at the center, the deflecting bricks 7 are placed surrounding the checker bricks 5, and the support bricks 6 are placed surrounding the deflecting bricks 7.

[0174] In this arrangement, it is desirable that the deflecting plane S3 is in a hexagonal prism where the deflecting bricks 7 are arranged. It is also desirable that the horizontal passages 35 are oriented outward from each edge of the hexagon where the deflecting bricks 7 are arranged, in a direction intersecting with the edges.

[0175] Even the second embodiment can provide the same advantages as the previously described first embodiment.

Third Exemplary Embodiment

[0176] Figs. 11 to 14 show a third exemplary embodiment of the invention.

[0177] In the first exemplary embodiment, the checker bricks 5, the support bricks 6, and the deflecting bricks 7 respectively have the basic shapes 5P, 6P and 7P in a hexagonal prism in common, which is suitable for a running bond pattern.

[0178] In contrast, in the third exemplary embodiment, support bricks 6A, 6B, and deflecting bricks 7A are used to simplify and share components for forming a support structure 32A.

[0179] In Fig. 12, the support brick 6A includes a brick body 60A mold from a refractory brick, in which an upper surface 61A and a lower surface 62A of the brick body 60A are rectangular; a first pair of side surfaces 63A is a trapezoid narrowing downward; and a second pair of side surfaces 64A is in a slanted rectangle.

[0180] Herein, considering an overlap, a width of each of short sides of the upper surface 61A is equal to or more than a length of one side of the hexagon of the basic shape 5P of the checker brick 5. A height of the brick body 60A is equal to a height of the checker brick 5.

[0181] Accordingly, the support brick 6A can be stacked in combination with the checker brick 5.

[0182] As can be seen from Fig. 13, the support brick 6B includes a brick body 60B and a side surface 64B that are the same as those of the support brick 6A. However, the brick body 60B and the side surfaces 64B are respectively in a vertically inverted shape of the brick body 60A and the side surfaces 64A of the support brick 6A. Accordingly, the inversed support brick 6A can be used as the as the support brick 6B.

[0183] In Figure 14, the deflecting brick 7A includes a brick body 70A and side surfaces 74A. The brick body 70A and the side surfaces 74A are the same as the brick body 60A and the side surfaces 64A of the support brick 6A.

[0184] Further, in the deflecting brick 7A, deflecting passages 75A, 77A shaped in a groove are formed on the upper surface 71A. Both ends of each of the deflecting passages 75A, 77A are opened on the side surfaces 74A. The deflecting passages 75A, 77A are the same as the deflecting passages 75, 77 in the above first exemplary embodiment, where the bottom surface 76A of the deflecting passages is slanted like a mountain toward ends of each of the deflecting passages 75A, 77A.

[0185] As illustrated in Fig. 11, the above support bricks 6A, 6B and the deflecting bricks 7A are stacked in order from the bottom in the checker chamber 3 (see Fig. 2) to form the support structure 32A.

[0186] Also in the third exemplary embodiment, the deflecting bricks 7A are arranged along the imaginary V-shaped deflecting plane S1, S2 (see Fig. 3) in the same manner as in the first exemplary embodiment.

[0187] In the first exemplary embodiment, the support bricks 6, the deflecting bricks 7, and the checker bricks 5 are stacked in a running bond pattern to form the support structure 32. The heat storage 31 above the support structure 32 is also formed by stacking the checker bricks 5 in a running bond pattern.

[0188] In contrast, in the third exemplary embodiment, the heat storage 31, which includes a course formed only of the checker bricks 5 and courses formed above the course, is formed in a running bond pattern, and the support structure 32A and the checker bricks 5 in the same courses (i.e., the lower part of the heat storage 31) are stacked in a flue chimney stack bond pattern, thereby providing a hybrid bond pattern of a running bond pattern and a flue chimney stack bond pattern.

[0189] Note that, in the heat storage 31 including the course formed only of the checker bricks 5 and the courses formed above the course, the checker bricks 5 may be stacked in a flue chimney stack bond pattern instead of a running bond pattern.

[0190] As shown in Fig. 11, the support bricks 6B are arranged at the bottom surface of the checker chamber 3 as the lowest course in the support structure 32A. The support bricks 6B are arranged along a direction orthogonal to the reference axis A. A predetermined distance is secured between each of the rows of support bricks 6B.

[0191] In the second course, the deflecting bricks 7A are arranged on the support bricks 6B near the reference axis A, and the support bricks 6A arranged on the support bricks 6B outside of the deflecting bricks 7A.

[0192] In the third course, the checker bricks 5 are arranged on the deflecting bricks 7A, and the support bricks 6B arranged on the support bricks 6A.

[0193] In the fourth course, the checker bricks 5 are arranged concentrically on the checker bricks 5 (in the flue chimney stack bond pattern). The deflecting bricks 7A are also arranged on the support bricks 6B in a region adjacent to the checker bricks 5. The support bricks 6A are arranged on the support bricks 6B outside of the deflecting bricks 7A.

[0194] Thereafter, repeating these steps, the region of checker bricks 5 in the section near the reference axis A expands outward, and at the point where an entire course includes all checker bricks 5, the bond pattern of the checker bricks 5 is switched to a running bond pattern, thereby forming the heat storage 31.

[0195] In the support structure 32A built in this manner, the slanted side surfaces 64A of the stacked the support bricks 6A, 6B and the stacked deflecting brick 7A on the support brick 6B define a space. This space provides the horizontal passage 35A extending outward and orthogonal to the reference axis A along the row of the support bricks 6A, 6B.

[0196] In the heat storage 31, the through-holes 54 of the checker bricks 5 are connected to each other in both of the section formed in the running bond pattern and the section formed in the flue chimney stack bond pattern. The through-holes 54 in the lowest end of checker bricks 5 are connected to the deflecting passages 75A, 77A in the deflecting bricks 7A and further connected from the opening in the side surface 74A to the horizontal passages 35A.

[0197] Accordingly, in the third exemplary embodiment, the vertically moving gas Gv from the heat storage 31 (see Fig. 3) changes direction at the deflecting bricks 7A, and is led to the horizontal passages 35A as the horizontally moving gas Gh (see Fig. 3) in the same manner as in the first exemplary embodiment.

[0198] Thus, the support structure 32A in the third exemplary embodiment can provide the same advantages as in the first exemplary embodiment.

[0199] Further, in the third exemplary embodiment, the support bricks 6A, 6B and deflecting bricks 7A are used as the components for forming the support structure 32A and have a simple shape.

[0200] The support bricks 6B can share the support of the support bricks 6A and the support of the deflecting bricks 7A, and each of the support brick 6B has a inverted shape of each of the support bricks 6A. Accordingly, only two types of the support bricks 6A and the deflecting bricks 7A need to be prepared, thereby simplifying construction and reducing the production costs.

Fourth Exemplary Embodiment

[0201] Figs. 15 to 19 show a fourth exemplary embodiment of the invention.

[0202] Although the V-shaped deflecting plane S1, S2 is used in the first and third exemplary embodiments, a substantially cone-shaped (pyramid-shaped) deflecting plane S3 is used in the second exemplary embodiment. However, in the fourth exemplary embodiment, a horizontal deflecting plane S4 is used.

[0203] Moreover, in the first and third exemplary embodiments, the support bricks 6, 6A, 6B are used as the support members. However, in the fourth exemplary embodiment, a support column 8 is used as the support member.

[0204] In Fig. 15, a support structure 32C is arranged on the bottom of the furnace shell 30 in the checker chamber 3, and the support structure 32C supports the heat storage 31 formed of the checker bricks 5.

[0205] As shown in Fig. 16, the support structure 32C includes support columns 8 arranged on the bottom of the checker chamber 3 and deflecting bricks 7C supported on upper ends of the support columns 8, where the deflecting bricks 7C are arranged along the horizontal deflecting plane S4.

[0206] A space is formed between the support columns 8. The space between the support columns 8 and the cylindrical space between the support structure 32C and the furnace shell 30 define a large confluence space 33C under the deflecting plane S4.

[0207] A ventilation pipe 34 is connected to the side of the furnace shell 30 for connecting to the confluence space 33C.

[0208] The support columns 8 are provided by connecting a plurality of cylindrical support column components 80.

[0209] As illustrated in Fig. 17, each of the support column components 80 includes a circular upper surface 81 and lower surface 82, and a cylindrical peripheral surface 83. The support column components 80 are formed of a highly heat-resistant ceramic material.

[0210] As illustrated in Fig. 18, each of the deflecting bricks 7C includes an inverse truncated cone-shaped brick body 70C.

[0211] The brick body 70C includes a circular upper surface 71C and lower surface 72C and a conical side surface 74C. The lower surface 72C is shaped identically to the upper surface 81 of the support column components 80 and connectable to the upper surface of each of the support column 8.

[0212] In the deflecting brick 7C, deflecting passages 75C, 77C shaped in a groove are formed on the upper surface 71C. Both ends of each of the deflecting passages 75C, 77C are opened on the side surfaces 74C. The deflecting passages 75C, 77C are the same as the deflecting passages 75, 77 in the above first exemplary embodiment, where the bottom surface 76A of the deflecting passages is slanted like a mountain toward ends of each of the deflecting passages 75C, 77C.

[0213] Referring back to Fig. 16, the deflecting bricks 7C are supported on the support columns 8 to form the support structure 32C. When the checker bricks 5 are arranged on the upper surfaces of the deflecting bricks 7C, the through-

holes 54 therein are connected to the deflecting passages 75C, 77C and connected to the confluence space 33C from the opening of the deflecting passage on the side surface 74C.

[0214] Accordingly, also with the support structure 32C in the fourth exemplary embodiment, ventilation can be conducted from the through-holes 54 in the checker bricks 5 of the heat storage 31 through the deflecting passages 75C, 77C to the confluence space 33C and the ventilation pipe 34.

[0215] In the fourth exemplary embodiment, the checker bricks 5 are identical to those in the first exemplary embodiment (see Fig. 5). Only the checker bricks 5 stacked at the lowest course in the heat storage 31, (i.e., the checker bricks 5 directly supported on the deflecting bricks 7C) are defined as flow rate adjustment checker bricks 5C shown in Fig. 19.

[0216] The flow rate adjustment checker bricks 5C each have basically the same structure as the checker bricks 5 described with reference to Fig. 5. However, the flow adjustment checker bricks 5C each have multiple types of through-holes 54 with different cross-sectional areas.

[0217] In Fig. 19, a through-hole 54A has the same dimensions as the through-hole in the checker brick 5 described with reference to Fig. 5. A through-hole 54B is formed with a cross-sectional area smaller than that of the through-hole 54A. A through-hole 54C is formed with a cross-sectional area smaller than that of the through-hole 54B.

[0218] By using the thus structured flow rate adjustment checker brick 5C, airflow can be restricted at the lowest course in the heat storage 31 although the through-holes 54 of the checker bricks 5 stacked on the flow rate adjustment checker brick 5C have the same dimension.

[0219] For instance, when flow resistances are different at the deflecting passages 75C, 77C continuous to the through-holes 54, the flow rate is larger at the through-holes 54 where the flow resistance is low (from the lower end to the upper end of the heat storage 31) whereas the flow rate is smaller at the through-holes 54 where the flow resistance is high, which results in imbalance.

[0220] In contrast, when the flow rate adjustment checker bricks 5C are used to use the through-holes 54A to 54C depending on the flow resistances at the deflecting bricks 7C and the like, the flow rates of the through-holes 54 can be balanced.

Fifth Exemplary Embodiment

[0221] Figs. 20 to 21 show a fifth exemplary embodiment of the invention.

[0222] In the fifth exemplary embodiment, the same components as those in the fourth exemplary embodiment are used except for some components. Accordingly, the components having the same structure are given the same reference numerals and the descriptions thereof are omitted. Differences are described below.

[0223] In the fourth exemplary embodiment, the support columns 8 are provided by connecting the cylindrical support column components 80.

[0224] Although the support columns 8 are also provided by connecting the cylindrical support column components 80 in the fifth exemplary embodiment, a spacer 84 is interposed between the support column components 80 as shown in Fig. 21.

[0225] In Fig. 22, the spacer 84 includes: a base 85 having the same diameter as that of the support column component 80; and prismatic protrusions 86 formed around the base 85.

[0226] The protrusions 86 are formed from the base 85 in six directions corresponding to the hexagonal prism shape of the checker bricks 5 used in the fifth exemplary embodiment.

[0227] As shown in Fig. 20, when the spacer 84 is sandwiched between the support column components 80, the base 85 is continuous to the support column components 80 and the protrusions 86 protrude in six directions.

[0228] When the support columns 8 formed by connecting the spacers 84 and the support column components 80 are arranged on the bottom surface of the checker chamber 3, in adjacent ones of the support columns 8, adjacent protrusions 86 contact each other.

[0229] With this arrangement, even if eventually one of the support column 8 is about to fall, the support column 8 can be supported via the protrusions 86 contacting each other. Accordingly, a strength of the support columns 8 can be increased to increase a strength of the support structure 32C.

[0230] Moreover, since the protrusions 86 protrude into the confluence space 33C, turbulence can be generated in the gas passing through the confluence space 33C.

Modification(s)

[0231] It should be understood that the scope of the present invention is not limited to the above-described exemplary embodiments but includes modifications and improvements as long as the modifications and improvements are compatible with the present invention.

[0232] For instance, in order to form the horizontal passages 35, in the deflecting brick 7 and the support brick 6 in the first exemplary embodiment, the opposite corners of the basic shapes 7P, 6P in a hexagonal prism are cut out from

the upper end to the lower end to form the auxiliary side surfaces 74, 64. However, the cutout portions to provide the horizontal passages 35 may be provided by cutting only a height-directional part of each of the deflecting brick 7 and the support brick 6.

[0233] In Fig. 22, in the pair of opposite corners of the deflecting brick 7, the corners connecting the upper surface 71 and the lower surface 72 are cut to provide the auxiliary side surfaces 74. However, a middle part of each of the same corners may be left uncut with the two side surfaces 73 meeting each other.

[0234] Even with the thus structured deflecting brick 7, the horizontal passages 35 (see Fig. 4) can be formed by the cutouts facing the upper and lower auxiliary side surfaces 74.

[0235] In Fig. 23, in the pair of opposite corners of the support brick 6, the corners connecting the upper surface 61 and the lower surface 62 are cut to provide the auxiliary side surfaces 64. However, a middle part of each of the same corners may be left uncut with the two side surfaces 63 meeting each other.

[0236] Even with the thus structured support brick 6, the horizontal passages 35 (see Fig. 4) can be formed by the cutouts facing the upper and lower auxiliary side surfaces 64.

[0237] In Fig. 24, in the pair of opposite corners of the support brick 6, a middle part of each of the same corners is cut to provide the auxiliary side surface 64. However, the portions connecting the upper surface 61 and the lower surface 62 are left uncut with the two side surfaces 63 meeting each other.

[0238] Even with the thus structured support brick 6, the horizontal passages 35 (see Fig. 4) can be formed by the cutouts facing the auxiliary side surface 64 in the middle.

[0239] In each of the above exemplary embodiments, the bottom surfaces 76, 76C of the deflecting passages 75, 77, 75A, 77A, 75C, 77C allow two-way flow (the bottom surface is shaped in a mountain). However, the bottom surface of each of the deflecting passages is not limited to the bottom surface for the two-way flow, but may be a bottom surface allowing one-way flow.

[0240] The deflecting brick 7 in Fig. 25 has the same structure as in the first exemplary embodiment. However, only a first end of the deflecting passages 75, 77 shaped in a groove is opened on the side surface 73 or the auxiliary side surface 74.

[0241] The bottom surface 76 of each of the deflecting passages 75, 77 are slanted from a second end where the passages are not opened on the side surface 73 or the auxiliary side surface 74 toward the first end where the passages are opened on the side surface 73 or the auxiliary side surface 74.

[0242] Even with the thus structured deflecting brick 7, the through-holes 54 in the checker brick 5 stacked on the upper surface 71 are connected only to the horizontal passage 35 on one side (see Fig. 4). However, by arranging adjacent ones of the deflecting bricks 7 in alternately reversed orientations, the through-holes 54 can be alternately connected to the horizontal passages 35 on opposite sides, resulting in a balanced airflow as a whole.

[0243] Further, since the deflecting passages 75, 77 are formed for one-way flow, the molding is easy.

[0244] Although the deflecting passages 75, 77 in the deflecting brick 7 in Fig. 25 are one-way angled and oriented in the same direction, the orientation of the one-way deflecting passages 75, 77 may be alternately changed.

[0245] The deflecting brick 7 in Fig. 26 has the same structure as the deflecting brick 7 in Fig. 25. However, the deflecting passages 75, 77 are opened on alternate one of the side surface 73 and the auxiliary side surface 74.

[0246] With the thus structured deflecting brick 7, molding of the one-way deflecting passages 75, 77 can be facilitated and the airflow can be balanced with an individual deflecting brick 7 by separating the airflow from the through-holes 54 to both the sides of the deflecting brick 7.

[0247] Although the deflecting passages 75, 77 are top-open grooves across the entire length thereof in the above exemplary embodiments, a part or a whole of the top of each of the grooves may be covered.

[0248] The deflecting brick 7 in Fig. 27 has the same structure as in the first exemplary embodiment. However, the side edges of the upper surface 71 that meets the side surfaces 73 or the auxiliary side surfaces 74 remain, where the deflecting passages 75, 77 are formed in a pipe.

[0249] In the structure shown in Fig. 27, since the deflecting passages 75, 77 are formed in a linear pipe, the deflecting passages 75, 77 may be formed, for instance, by boring holes along the bottom surface 76 from both directions.

[0250] On the other hand, a first hole may be bored laterally from the side surfaces 73 or the auxiliary side surfaces 74, and a second hole may be bored from the upper surfaces 71 to connect with the first hole, so that deflecting passages 75, 77 in L-shaped pipe can be formed.

[0251] Thus, the deflecting passages 75, 77 are not limited to open groove passage channel structures, but may be shaped in a form of a tunnel, a linear pipe, or an L-shaped tunnel.

[0252] Further, the above-mentioned exemplary embodiments provide the deflecting passages 77 that form the deflecting passage 75 when adjacent deflecting bricks 7 are joined together. However, the deflecting brick may include just the deflecting passages 75 in accordance with the arrangement of the through-holes 54 in the checker bricks 5.

[0253] In the first to third exemplary embodiments, the deflecting bricks 7, 7A and the support bricks 6 are each given a basic shape 7P, 6P identical to the hexagonal prism shape of the checker bricks 5; however, without being limited thereto, other shapes such as a may be used.

[0254] In the fourth and fifth exemplary embodiments, the deflecting bricks 7C supported by the support columns 8 are arranged along the horizontal deflecting plane S4; however, the deflecting bricks 7C may be arranged along the V-shaped deflecting plane S1, S2 of the first exemplary embodiment, or arranged along the cone-shaped or pyramid-shaped deflecting plane S3 of the second exemplary embodiment. In this arrangement, the support column 8 is preferably structured so that the length thereof may be increased or decreased based on the height of the checker bricks 5 or the deflecting bricks 7C.

[0255] In the fourth and fifth exemplary embodiments, the support column 8 is formed by connecting the cylindrical support column components 80; however the support column components 80 may be prismatic. The support column 80 is provided not only by connecting the support column components 80 but also by a continuous material.

[0256] In the above exemplary embodiments, the deflecting bricks 7, 7A, 7C serve as the deflecting blocks, the support bricks 6, 6A, 6B serve as the support blocks, and a heat-resistant ceramic material is used for the support columns 8. However, the material is not limited to the refractory brick or heat-resistant ceramic material, but may be other heat-resistant inorganic materials.

[0257] Moreover, without being limited to non-metals, any metal material (e.g., cast iron) having heat resistance (i.e., high softening temperature, high melting temperature) and oxidation resistance (i.e., when blow-in oxygen is at a high concentration) may be used.

[0258] In the above exemplary embodiments, each of the checker bricks 5 includes 19 holes (i.e., 19 holes as the through-holes 54 per a single brick). However, the checker brick 5 may have other arrangements such as having nine holes or 37 holes. Additionally, the checker brick is not limited to the hexagonal shape in a plan view, but may be a cube, a cuboid, or an octagonal prism. When using different shapes for the checker bricks in this manner, the deflecting bricks 7 and the support bricks 6 also need to be changed correspondingly in terms of the shapes, the number and position of the grooves and the ventilating passages, thereby providing the deflecting passage based on the invention.

Six Exemplary Embodiment

[0259] Figs. 28 to 31 show a sixth exemplary embodiment of the invention.

[0260] In the above first exemplary embodiment (see Fig. 4) and third exemplary embodiment (see Fig. 11), the upper surfaces of the deflecting bricks 7, 7A and the lower surfaces of the checker bricks 5 are stacked in a running bond pattern. In other words, the checker bricks 5 in the upper course are stacked straddling the multiple deflecting bricks 7, 7A.

[0261] With this arrangement, the joints of the bricks in the upper and lower courses are mutually nonconsecutive, so that, for example, the load at the lower surface of the bricks in the upper course is not propagated vertically to a section exposed at a joint between the bricks in the lower course. Accordingly, the contact surface area used for propagating the load vertically between bricks is reduced, so that the load is received at a narrow contact surface and the compressive load at the contact surface is likely to be increased.

[0262] Since the load of all the bricks stacked above is received at the sections near the bottom in particular, the received load is enormous, leading to a concern that the deflecting bricks 7, 7A and the checker bricks 5 may have insufficient compressive strength.

[0263] In contrast, in the sixth exemplary embodiment illustrated in Fig. 28, the two lowest courses of the checker bricks 5 in the heat storage 31 are defined as checker bricks 5E. The checker bricks 5E and the deflecting bricks 7A immediately therebelow are arranged in a flue chimney stack bond pattern. Specifically, a single checker brick 5E sits on the upper surface of a single deflecting brick 7A.

[0264] The planar shape of the checker brick 5E is not the hexagon used for the checker brick 5. Similar to the support brick 6 in Figure 6 and the deflecting brick 7 in Figure 7, a pair of corners of the hexagon is cut out so that the planar shape of the checker brick 5E is substantially rectangular, and the cutout portion is defined as an auxiliary side surface 53E.

[0265] The deflecting brick 7A has an upper surface 71A having a planar shape that is a rectangle as illustrated in Fig. 14. Therefore, the entire lower surface of the checker brick 5E can exactly sit on the upper surface 71A of the deflecting brick 7A.

[0266] Consequently, the checker brick 5E and the deflecting brick 7A can be arranged in a vertically overlapping flue chimney stack bond pattern as illustrated in Fig. 28.

[0267] In the sixth exemplary embodiment, by arranging the checker brick 5E and the deflecting brick 7A in a flue chimney stack bond pattern, no section is exposed at a joint between the bricks on the respective lower surface and upper surface of the checker brick 5E and the deflecting brick 7A, thereby sufficiently ensuring the contact surface area for receiving the compressive load. Therefore, the concern of insufficient compressive strength between the checker brick 5E and the deflecting brick 7A can be resolved.

[0268] Note that, in the sixth exemplary embodiment, the hexagonal checker bricks 5 stacked on and above the checker bricks 5E are also arranged in a flue chimney stack bond pattern in the same manner as in the arrangement of the checker bricks 5E and the deflecting bricks 7A.

[0269] However, after arranging the checker bricks 5E and the deflecting bricks 7A in the flue chimney stack bond

pattern, the checker bricks 5E and the checker bricks 5 thereabove may be arranged in a running bond pattern.

[0270] Seventh Exemplary Embodiment

[0271] Figs. 29 to 30 show a seventh exemplary embodiment of the invention.

[0272] Although the external hot-blast stove (see Fig. 1) is employed in the above exemplary embodiments, an internal hot-blast stove 1F is employed in the seventh exemplary embodiment.

[0273] In Fig. 29, the hot-blast stove 1F includes a cylindrical furnace shell 90.

[0274] Inside the furnace shell 90, a combustion chamber 2F and a checker chamber 3F are separated by a partition 91. An upper portion of the furnace shell 90 is covered with a lid 92. An upper portion of the combustion chamber 2F and an upper portion of the checker chamber 3F are mutually connected through an inside of the lid 92.

[0275] As further illustrated in Fig. 30, the partition 91 is formed as a cylindrical surface with both edges bonded to the inner surface of the furnace shell 90 without any gaps.

[0276] While the inside of the combustion chamber 2F is a cavity, a refractory brick addition 93 is formed along the inner surface of the furnace shell 90, facing the combustion chamber 2F.

[0277] Inside the checker chamber 3F, the support structure 32 (or optionally the above support structures 32A, 32C) is formed at the bottom using support bricks 6 and deflecting bricks 7, and the heat storage 31 formed by stacking the checker bricks 5 is supported on the support structure 32. The support structure 32 is arranged so that the reference axis A is at the center of the partition 91 in a manner to be orthogonal to the partition 91.

[0278] The cylindrical ventilation space 33 is formed surrounding the support structure 32 between the support structure 32 and the furnace shell 90, with the ventilation pipe 34 formed in the side surface of the furnace shell 90 connected to the ventilation space 33. The ventilation space 33 in the sixth exemplary embodiment does not continue around the entire periphery of the support structure 32; a portion of the ventilation space 33 is blocked off at the partition 91.

[0279] Referring back to Fig. 29, the heating burner 21 is installed at the bottom of the combustion chamber 2F. The fuel gas supply pipe 22 and the outer-air supply pipe 23 are connected to the side surface at the bottom of the furnace shell 90. The hot-blast supply pipe 24 is connected to the side surface of the furnace shell 90 above the burner 21.

[0280] The above components from the burner 21 to the hot-blast supply pipe 24 are identical to the components in the first exemplary embodiment. With these components, a high-temperature fuel gas generated at the burner 21 passes through the inside of the lid 92 and is supplied to and stored in the checker chamber 3F. Furthermore, the hot blast heated in the checker chamber 3F can pass through the inside of the lid 92 and be fed into the combustion chamber 2F, and be supplied to the blast furnace via the hot-blast supply pipe 24.

[0281] Also in the seventh exemplary embodiment, with the support structure 32 using the support bricks 6 and the deflecting bricks 7 as well as the heat storage 31 formed by stacking the checker bricks 5, the same advantages as in the first exemplary embodiment can be obtained, and the modifications described for each of the embodiments may also be adopted in the seventh exemplary embodiment.

INDUSTRIAL APPLICABILITY

[0282] The present invention is applicable to a support structure supporting checker bricks in a hot-blast stove and deflecting blocks used in this support structure.

EXPLANATION OF CODE(S)

[0283]

1...	hot-blast stove
2, 2F...	combustion chamber
20...	furnace shell
21...	burner
22...	fuel gas supply pipe
23...	outer-air supply pipe
24...	hot-blast supply pipe
3, 3F...	checker chamber
30...	furnace shell
31...	heat storage
32, 32A, 32C...	support structure
33...	ventilation space
33C...	confluence space
34...	ventilation pipe
35, 35A...	horizontal passage

	39...	foundation brick
	4...	connecting pipe
	5, 5E...	checker brick
	50...	brick body
5	51...	upper surface
	52...	lower surface
	53...	side surface
	54, 54A, 54B, 54C...	through-hole
	55, 56...	groove forming a through-hole
10	5C...	flow rate adjustment checker brick
	5P, 6P, 7P...	basic shape in hexagonal prism
	6, 6A, 6B...	support brick
	60, 60A, 60B...	brick body
	61, 61A...	upper surface
15	62, 62A...	lower surface
	63, 63A...	side surface
	64...	auxiliary side surface
	64A, 64B...	side surface
	7, 7A, 7C...	deflecting brick
20	70, 70A, 70C...	brick body
	71, 71A, 71C...	upper surface
	72, 72C...	lower surface
	73...	side surface
	74...	auxiliary side surface
25	74A, 74C...	side surface
	75, 75A, 75C, 77...	deflecting passage
	76, 76A...	bottom surface
	8...	support column
	80...	support column component
30	81...	upper surface
	82...	lower surface
	83...	peripheral surface
	84...	spacer
	85...	base
35	86...	protrusion
	90...	furnace shell
	91...	partition
	92...	lid
	93...	refractory brick addition
40	A...	reference axis
	Gh...	horizontally moving gas
	Gh...	vertically moving gas
	Rh...	area of checker brick 5
	Rt...	area of deflecting brick
45	Rv...	area of support brick
	S1, S2, S3, S4...	deflecting plane

Claims

- 50
1. A deflecting block used in a support structure supporting checker bricks in a hot-blast stove, the deflecting block comprising:

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 - a brick body formed of a refractory material; and
 - a deflecting passage connected to through-holes of the checker bricks and being opened at an opening section on a side surface of the brick body.
 2. The deflecting block according to claim 1, wherein

the brick body is formed of a refractory brick.

3. The deflecting block according to claim 1 or 2, wherein
the deflecting passage is formed in a groove on an upper surface of the brick body.
- 5 4. The deflecting block according to claim 3, wherein
the deflecting passage comprises a bottom surface that is slanted downward from a connected portion between the
deflecting passage and the through-holes of the checker bricks toward the opening section on the side surface of
10 the brick body.
5. The deflecting block according to claim 3 or 4, wherein
the side surface of the brick body comprises opposite first and second side surfaces,
the connected portion between the deflecting passage and the through-holes is in a middle of the deflecting passage,
and
15 both ends of the deflecting passage are opened on the respective first and second side surfaces.
6. The deflecting block according to claim 3 or 4, wherein
the side surface of the brick body comprises opposite first and second side surfaces,
the deflecting passage comprises a plurality of deflecting passages arranged in parallel, and
20 adjacent ones of the deflecting passages are opened on the respective first and second side surfaces.
7. The deflecting block according to claim 3 or 4, wherein
the side surface of the brick body comprises opposite first and second side surfaces,
the deflecting passage comprises a plurality of deflecting passages arranged in parallel, and
25 all the deflecting passages are opened on one of the first and second side surfaces.
8. The deflecting block according to any one of claims 1 to 7, wherein
the brick body comprises a cutout formed by cutting opposite corners of a brick material shaped in a hexagonal
prism, and
30 the cutout defines a horizontal passage.
9. The deflecting block according to claim 8, wherein
the cutout is formed continuously from the upper surface to a lower surface of the brick body.
- 35 10. The deflecting block according to claim 8, wherein
the cutout is only formed in a part of the brick body between the upper surface and the lower surface of the brick body.
11. A support structure supporting checker bricks in a hot-blast stove, the support structure comprising:
40 the deflecting block according to any one of claims 1 to 10 supporting the checker bricks; and
a support member formed of a heat-resistant material and supporting the deflecting block, wherein
the deflecting block is arranged along an imaginary deflecting plane that partitions an inside of the hot-blast
stove into an upper side and a lower side, and
45 the deflecting block and the support member define the horizontal passage extending horizontally between the
deflecting block and the support member and connected to the opening section on the side surface of the
deflecting block.
12. The support structure according to claim 11, wherein
the support member is a support block having the same external dimensions as the deflecting block.
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13. The support structure according to claim 12, wherein
the deflecting block is a deflecting brick formed of a refractory brick, and the support block is a support brick formed
of a refractory brick.
- 55 14. The support structure according to claim 11, wherein
the support member is a support column formed of a refractory brick and supporting the deflecting block.
15. The support structure according to claim 14, wherein

the support column is in a form of a plurality of support column components connected together lengthwise.

5 16. The support structure according to any one of claims 11 to 15, wherein the deflecting plane is formed in a V-shape extending diagonally upward and away from a reference axis that traverses a bottom surface of the hot-blast stove.

10 17. The support structure according to any one of claims 11 to 15, wherein the deflecting plane is formed substantially in a cone or substantially in a pyramid extending diagonally upward toward a periphery of the hot-blast stove from a bottom surface thereof.

15 18. The support structure according to any one of claims 11, 14 and 15, wherein the deflecting plane extends horizontally.

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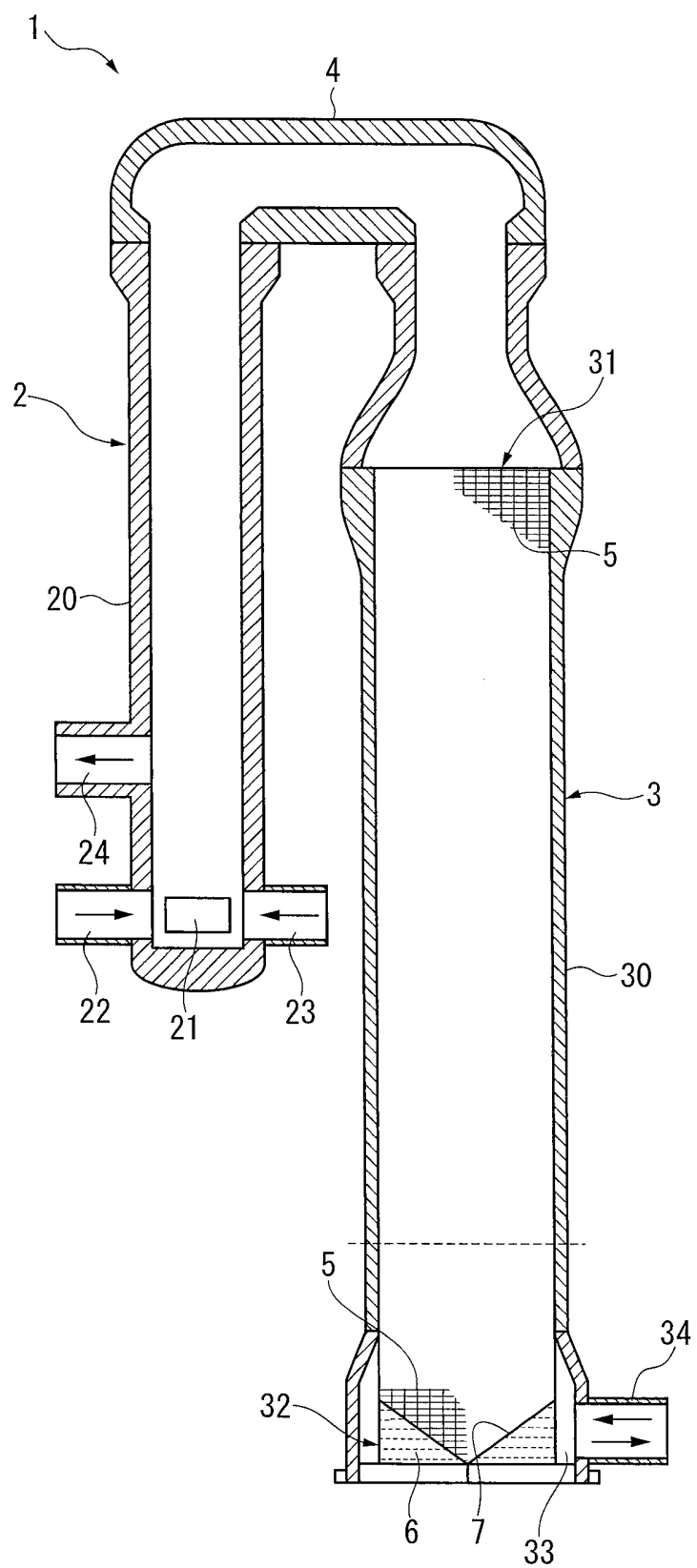


FIG. 1

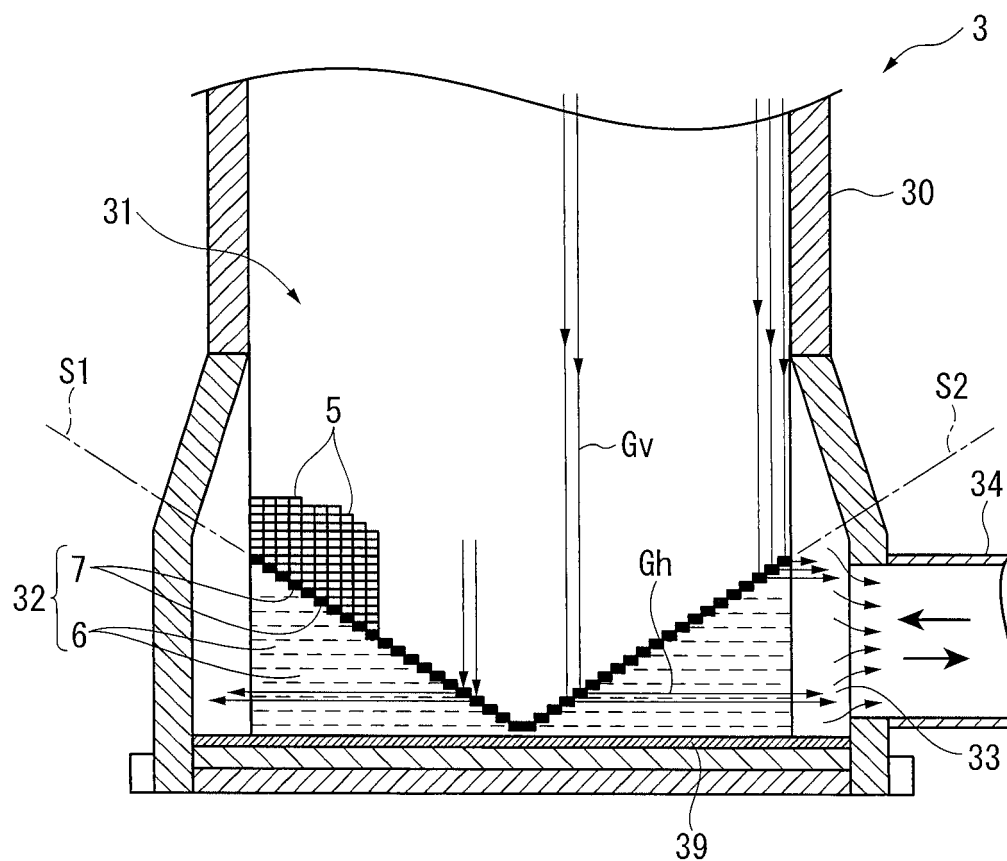


FIG. 2

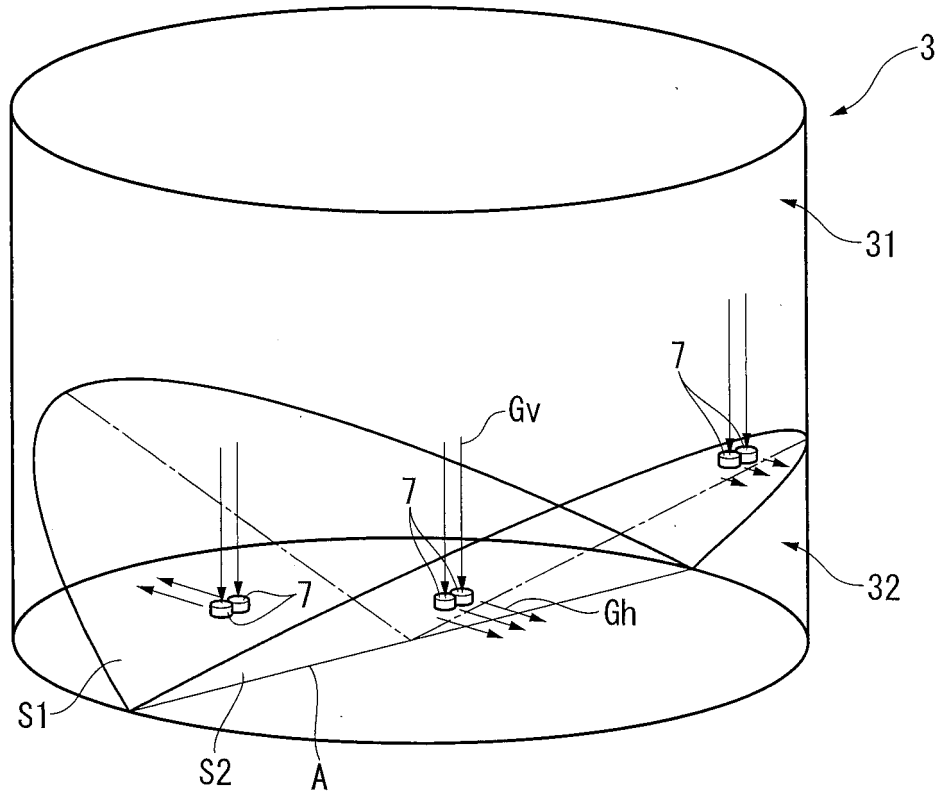


FIG. 3

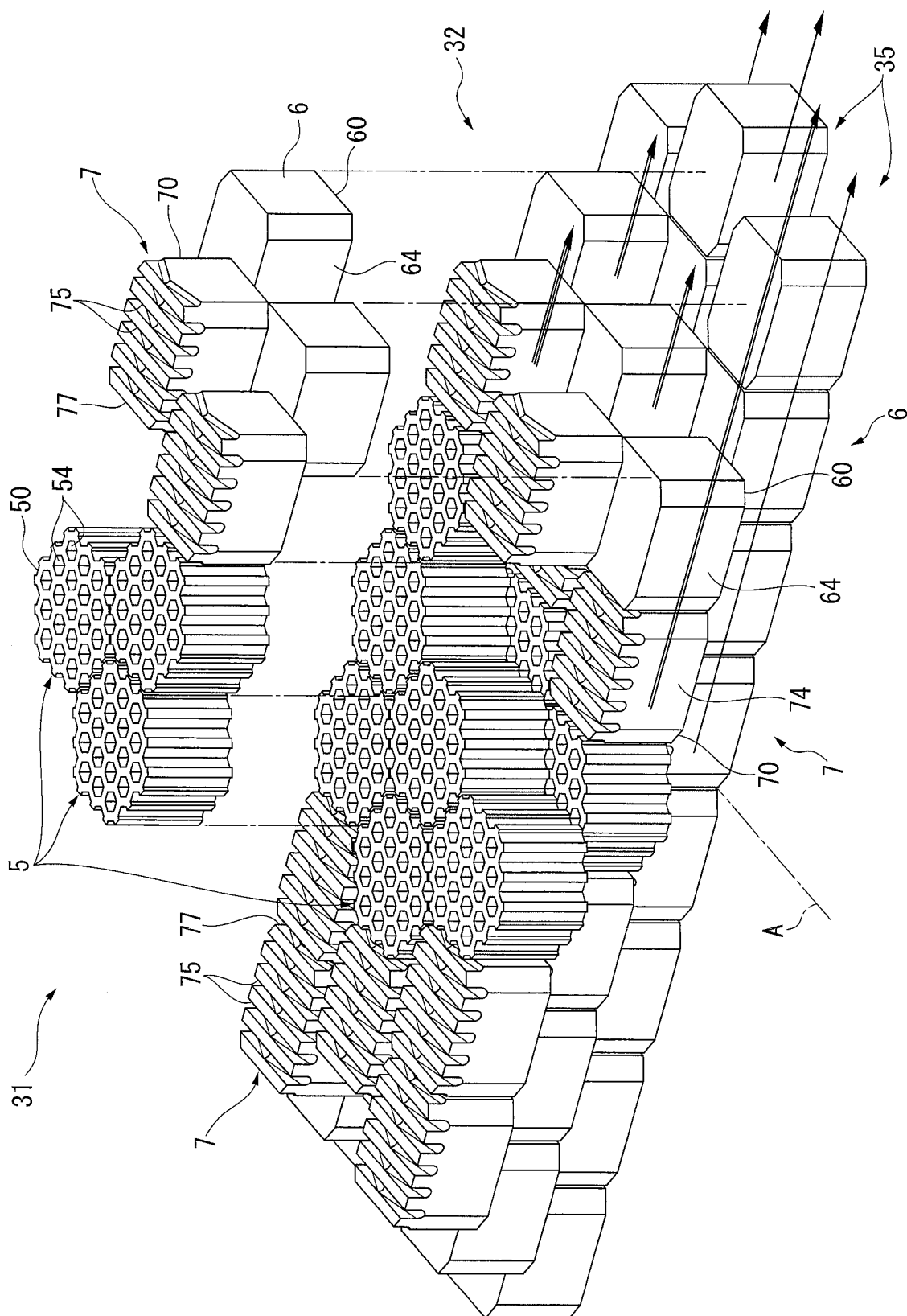


FIG. 4

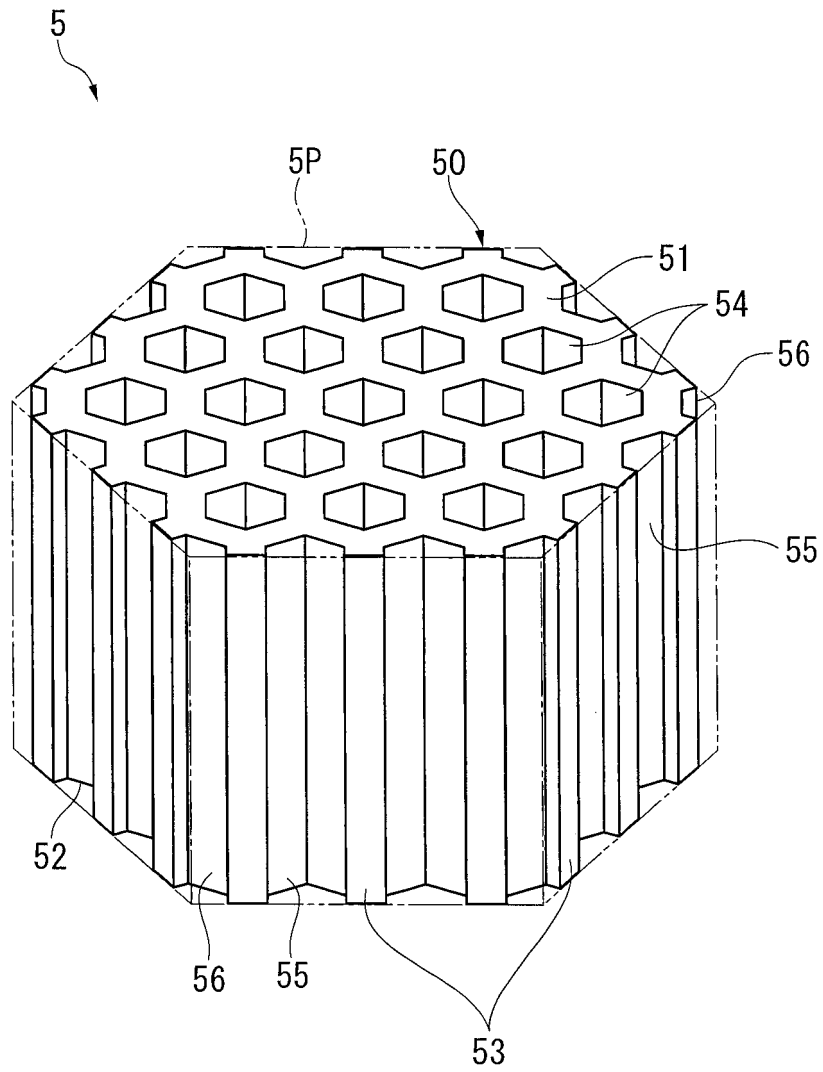


FIG. 5

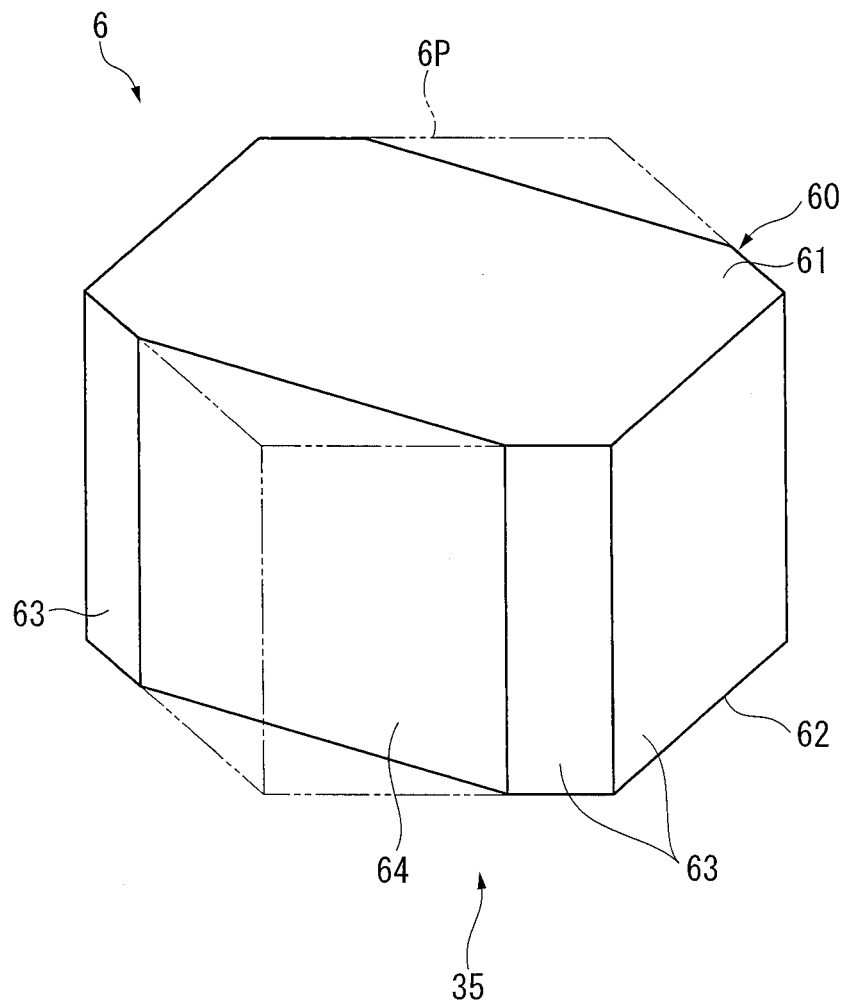


FIG. 6

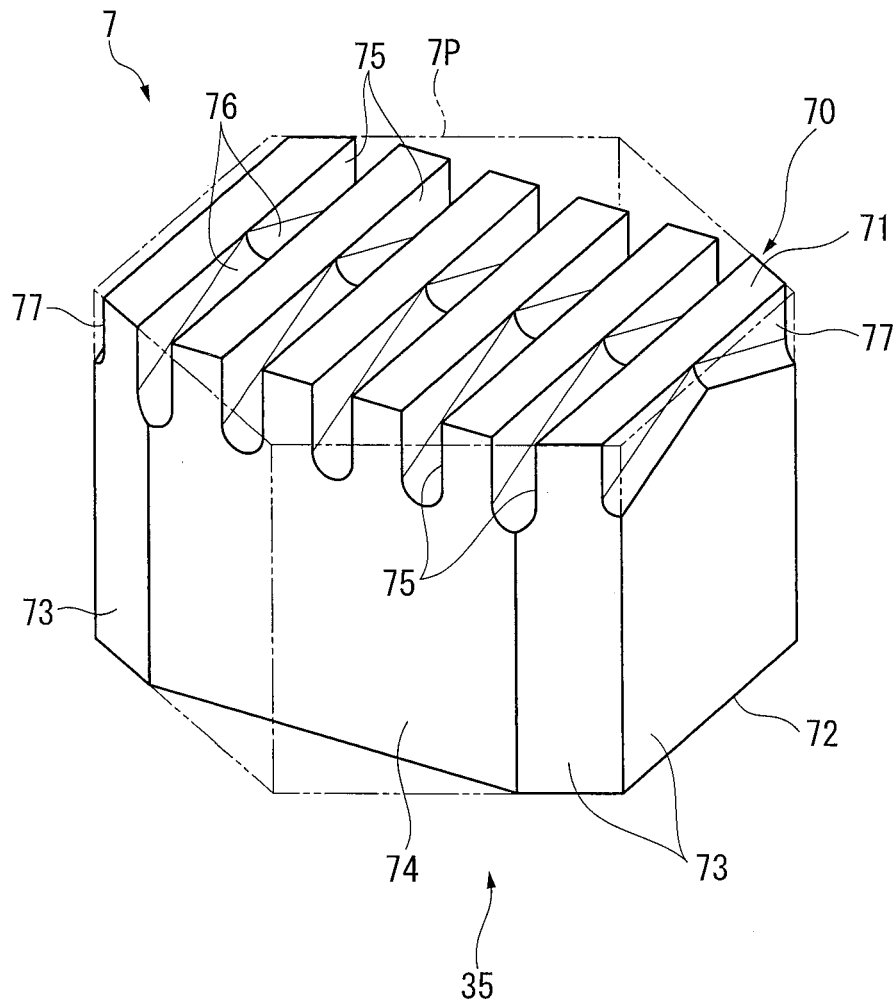


FIG. 7

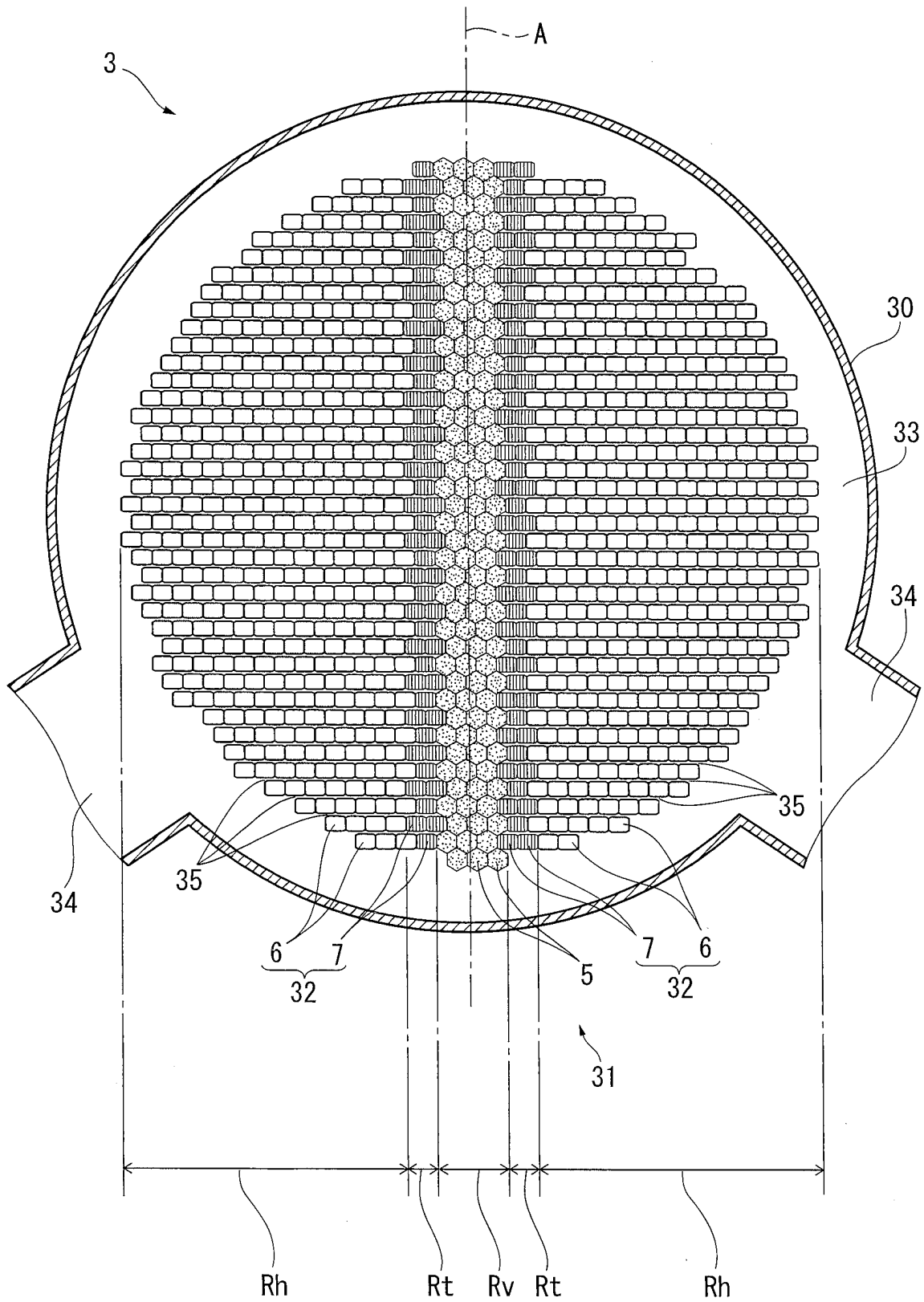


FIG. 8

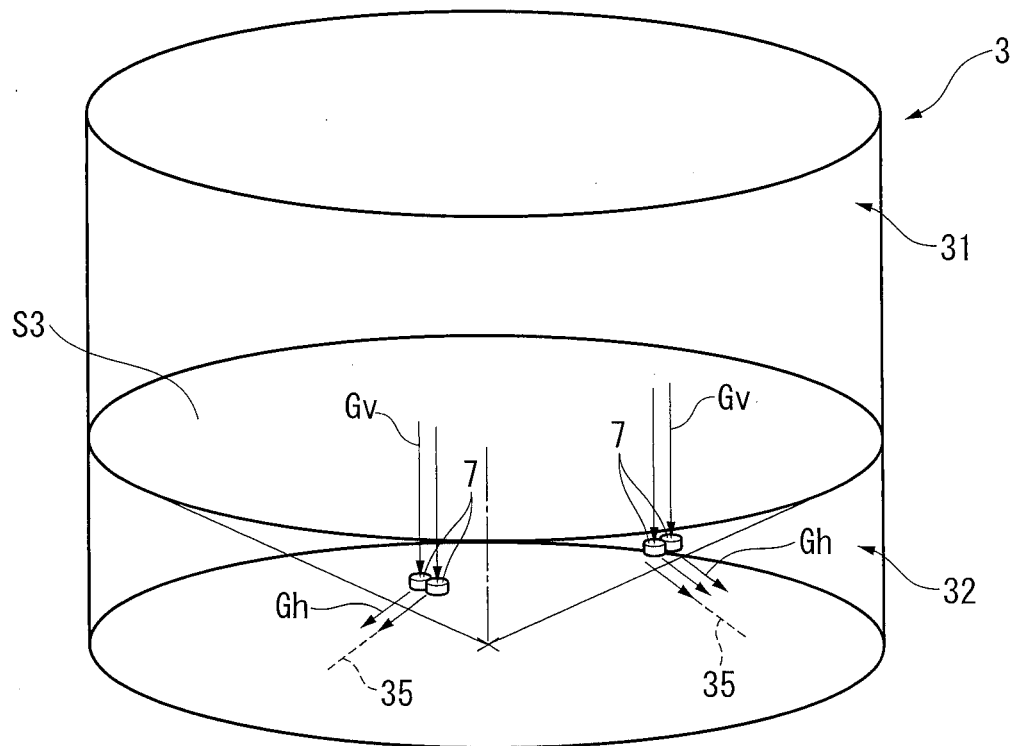


FIG. 9

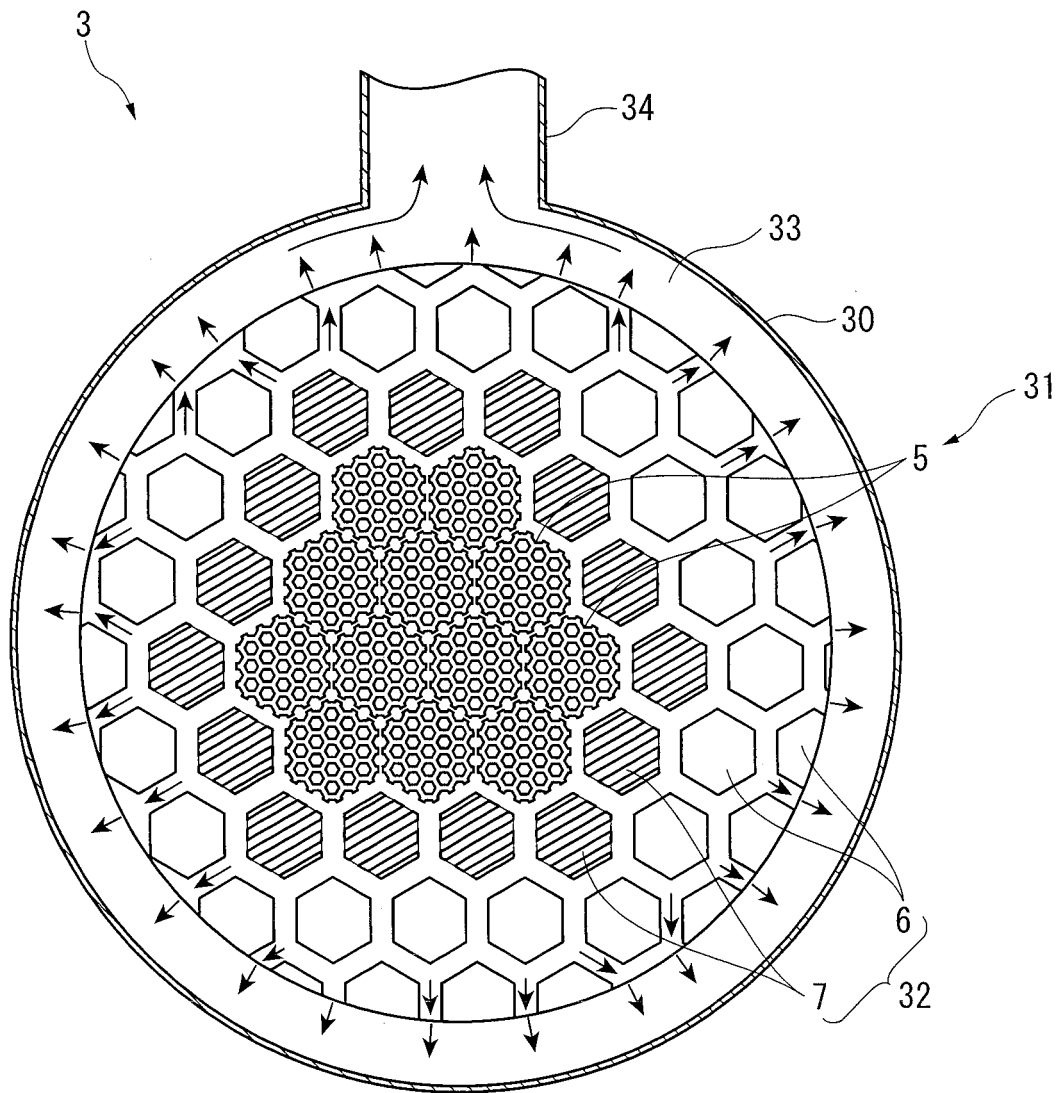


FIG. 10

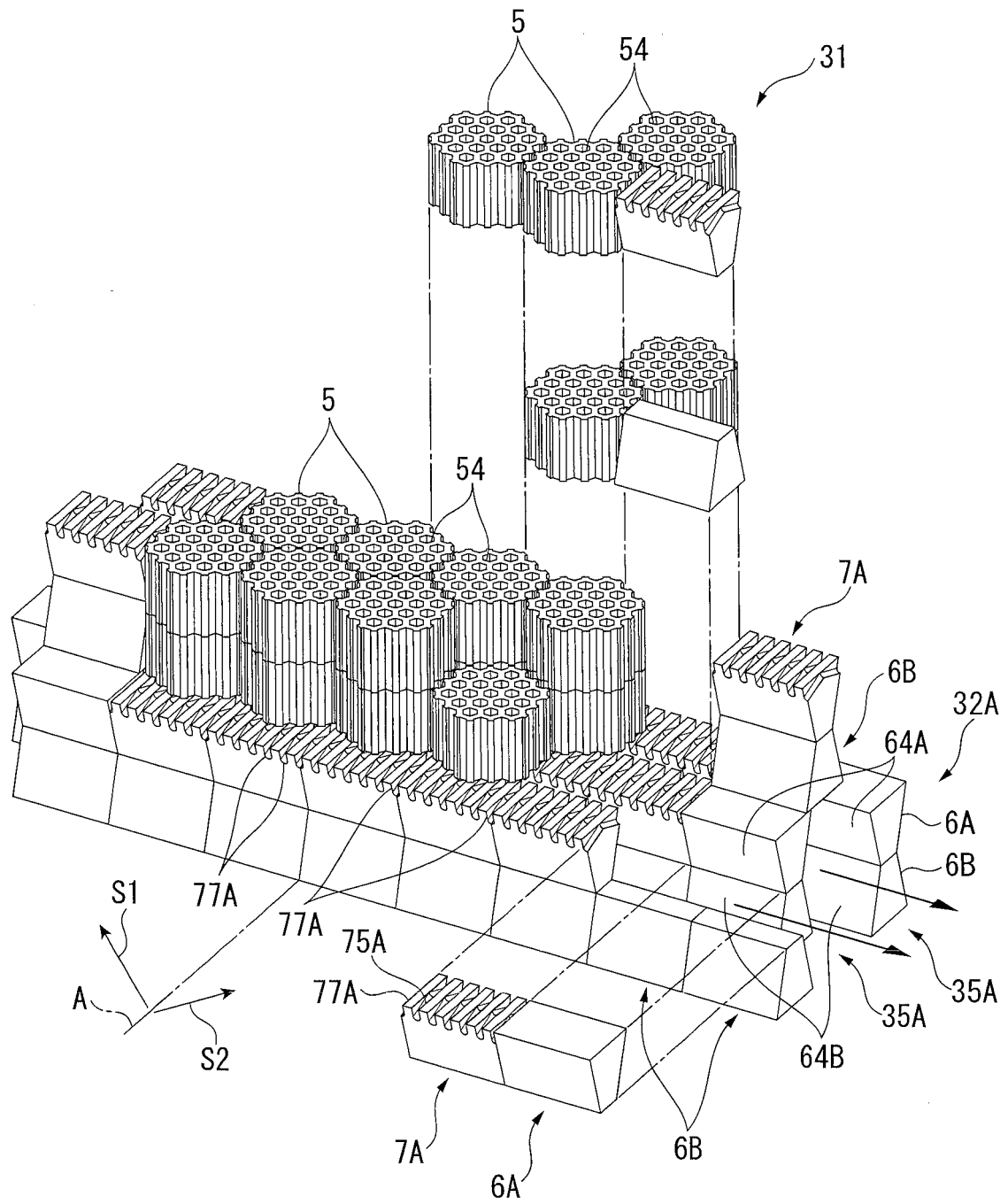


FIG. 11

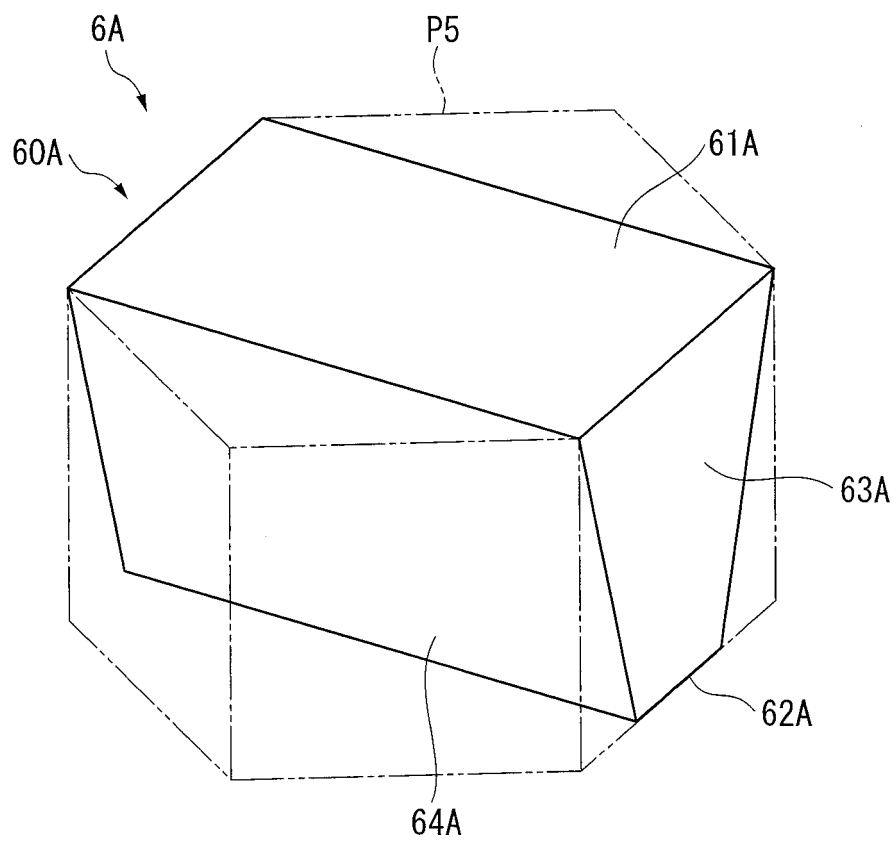


FIG. 12

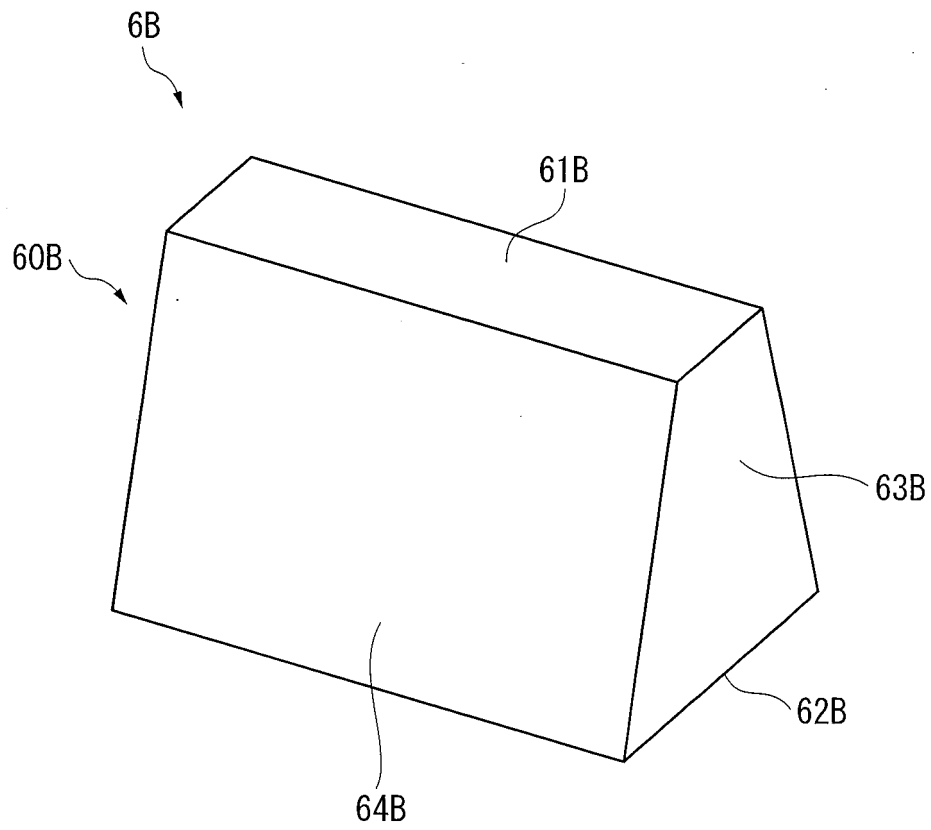


FIG. 13

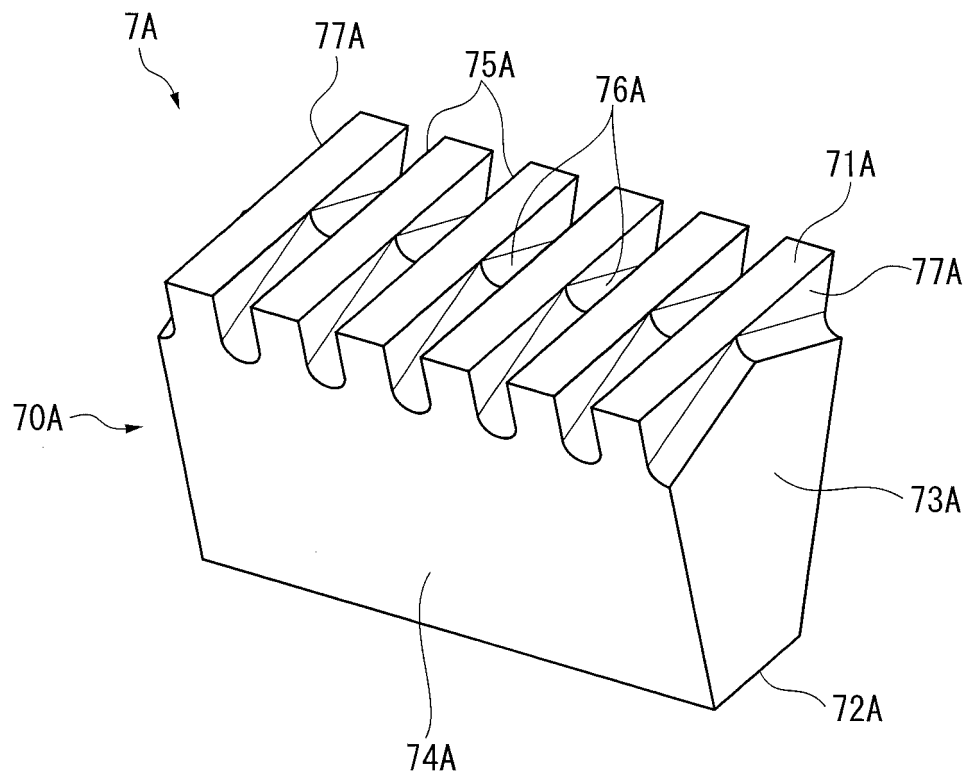


FIG. 14

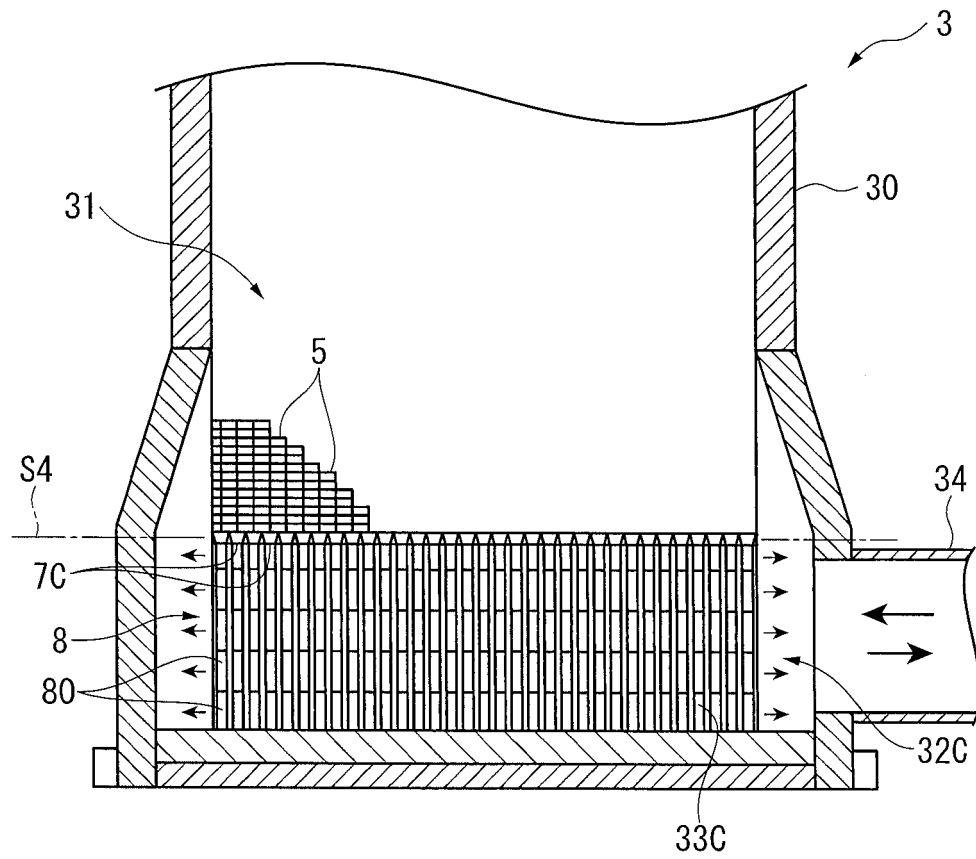


FIG. 15

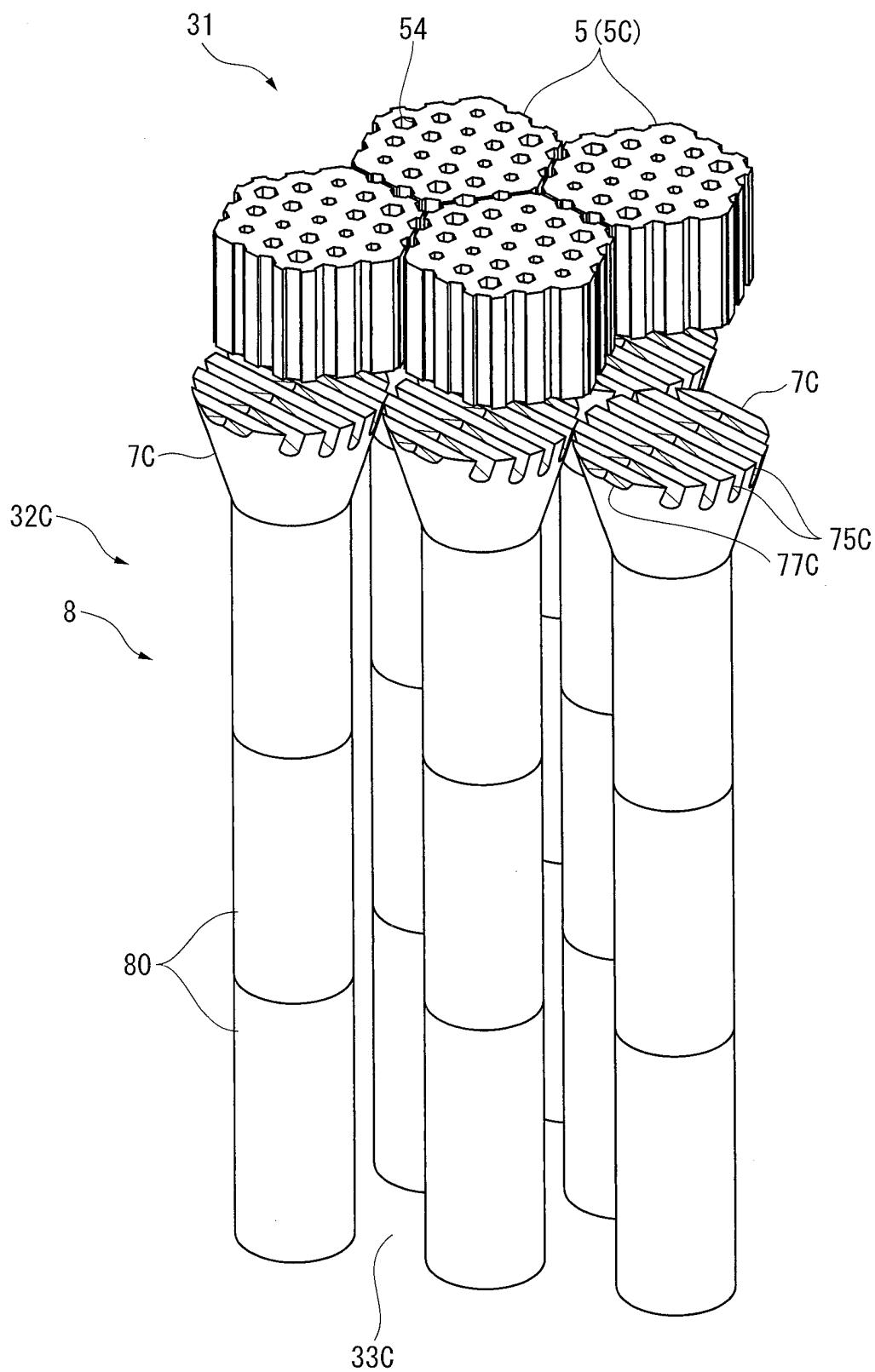


FIG. 16

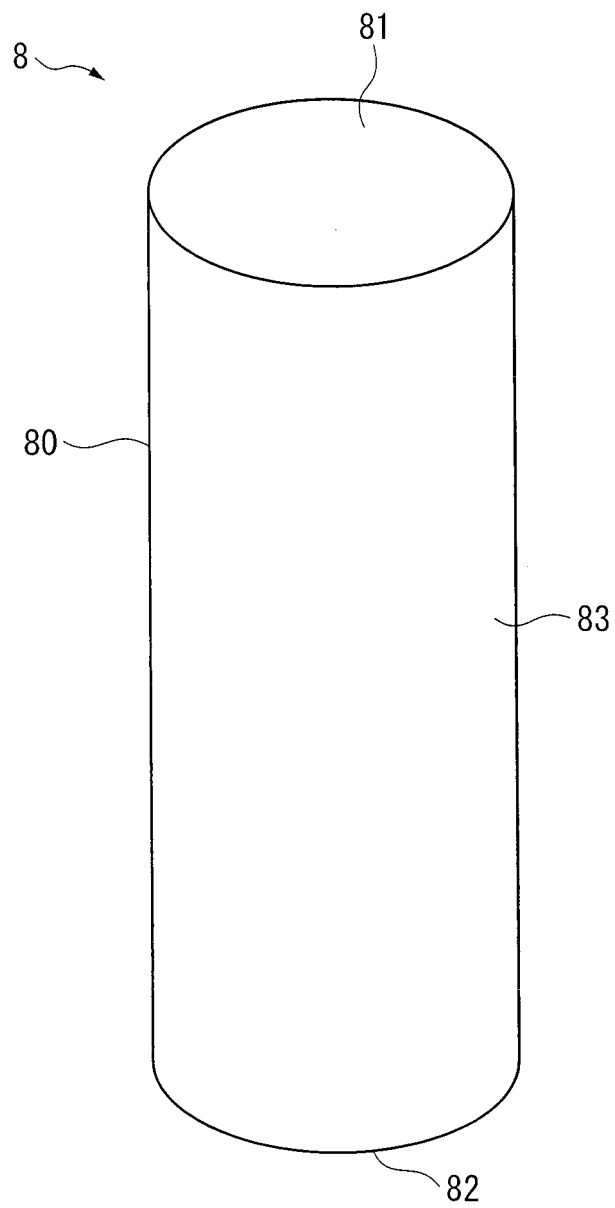


FIG. 17

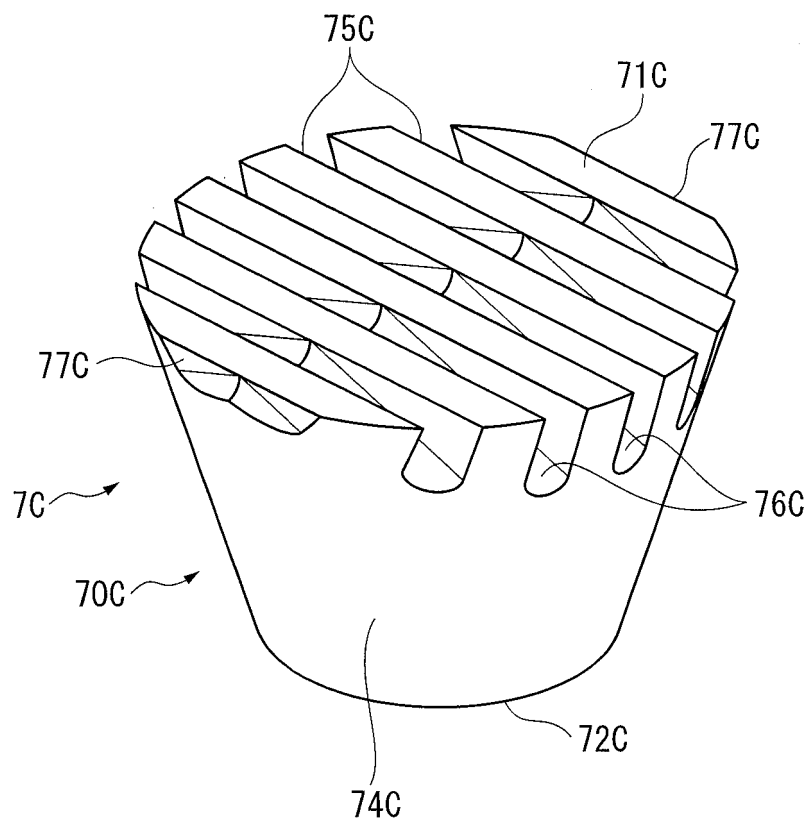


FIG. 18

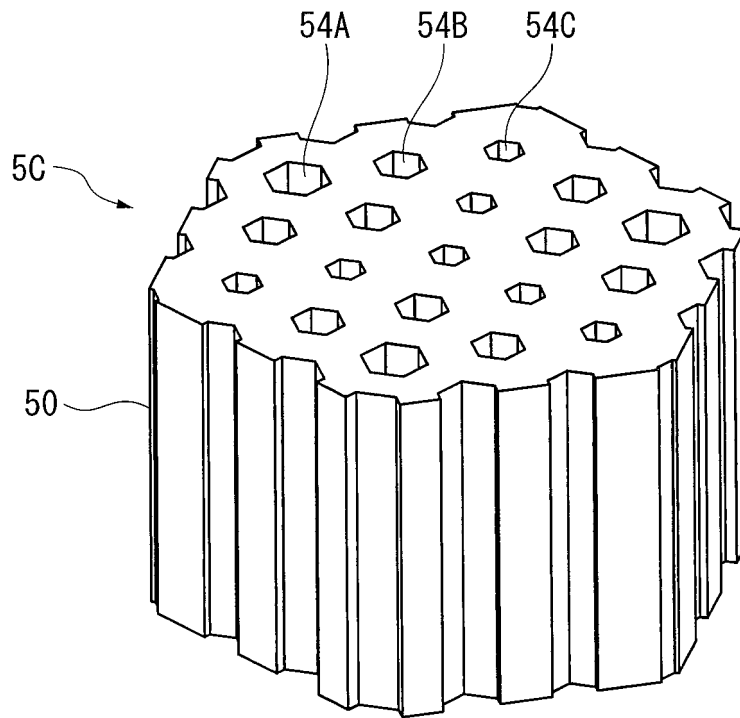


FIG. 19

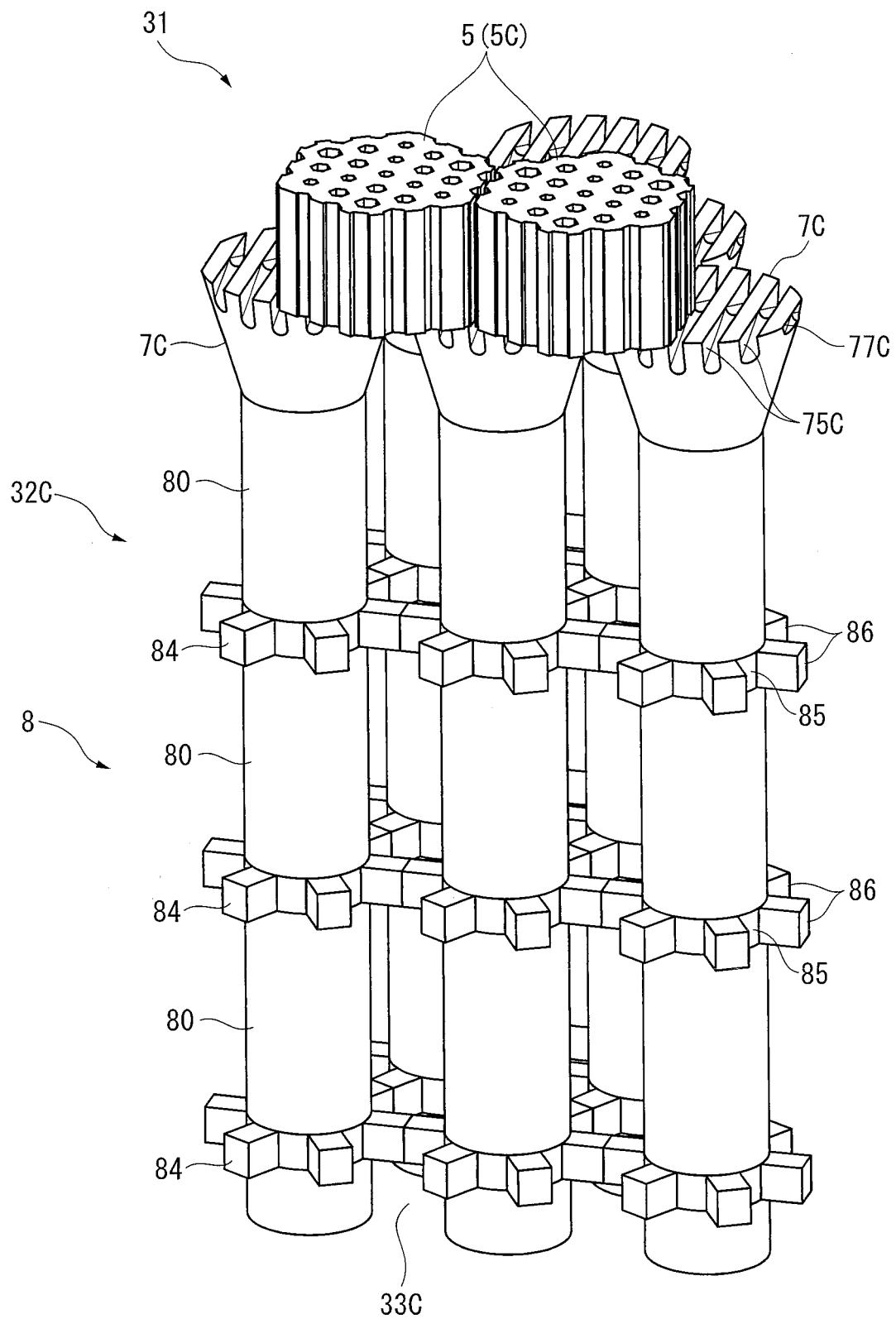


FIG. 20

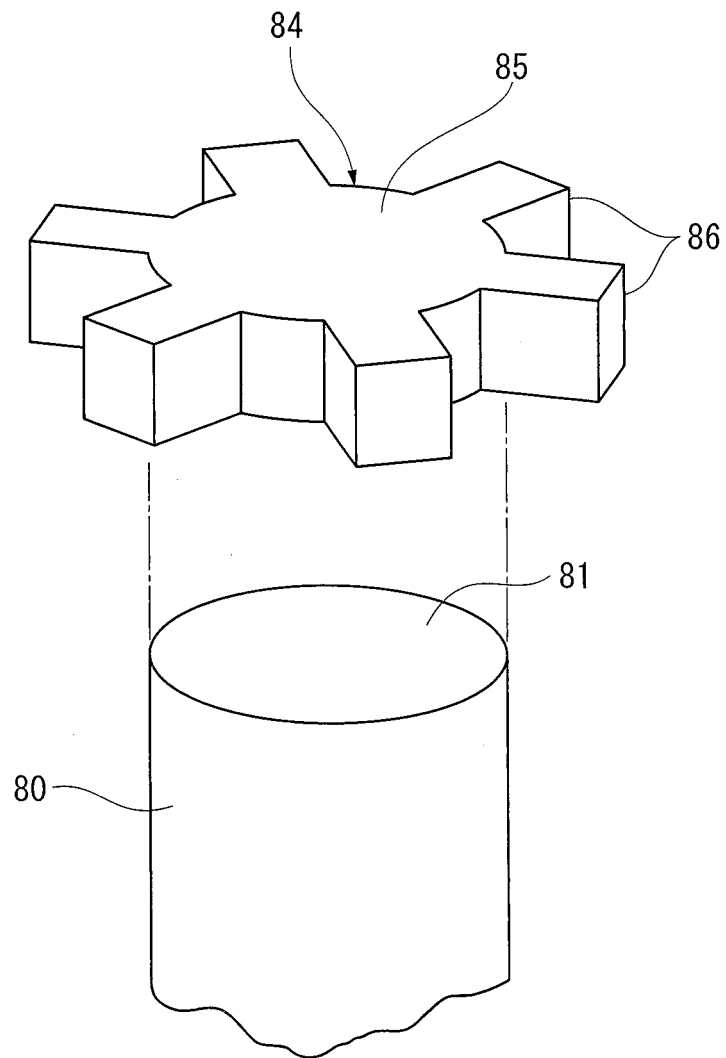


FIG. 21

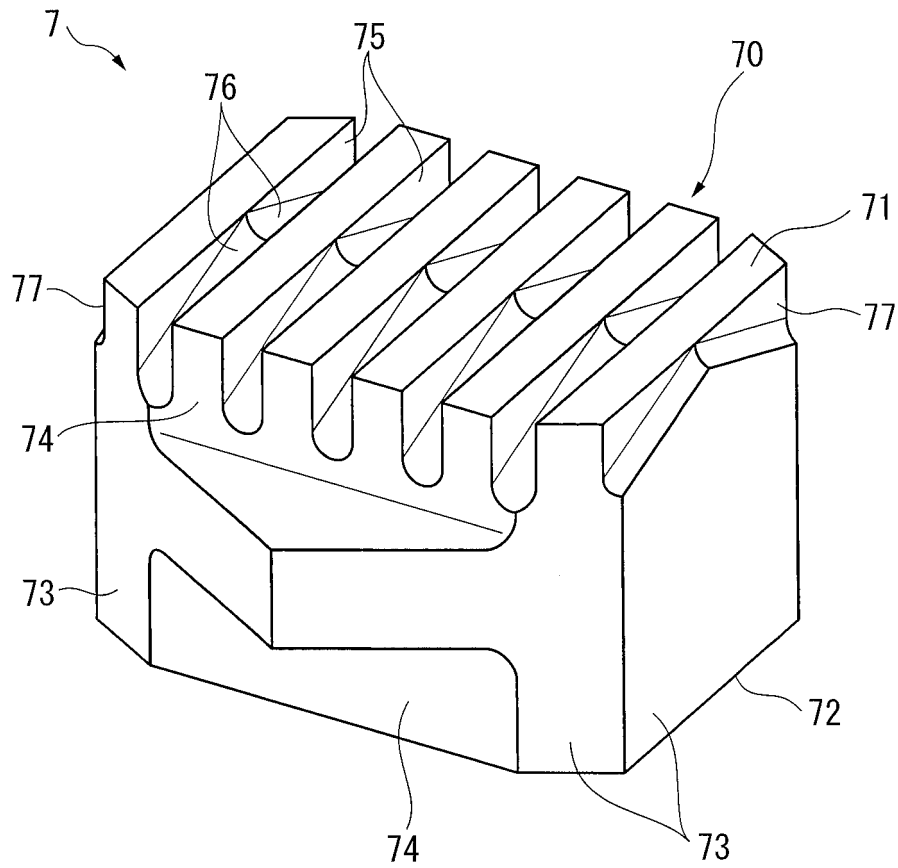


FIG. 22

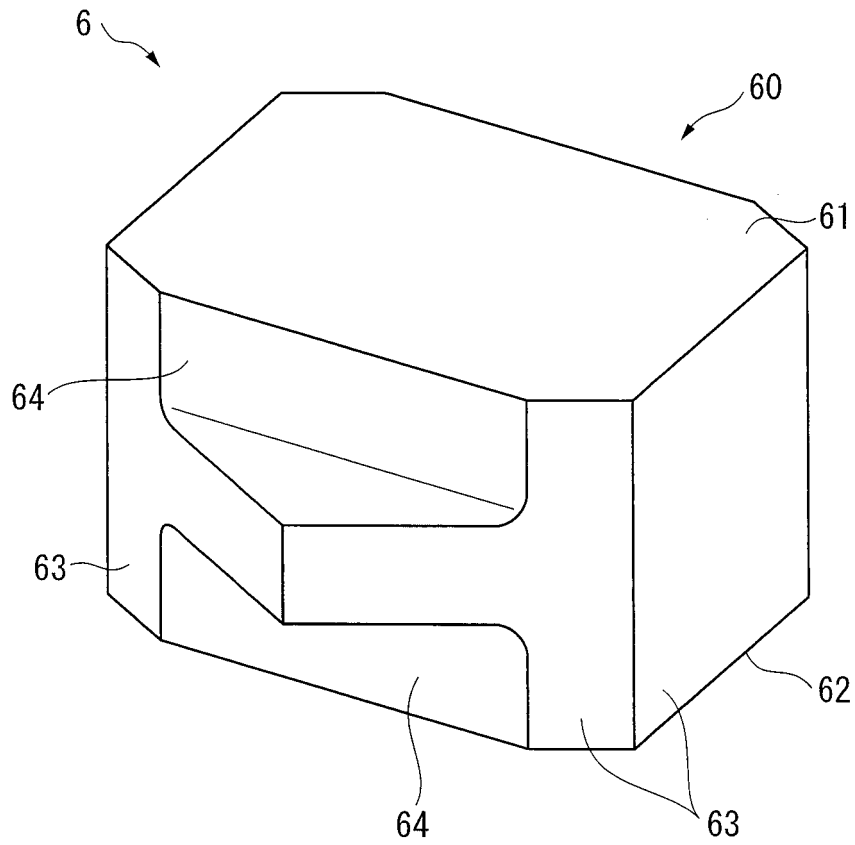


FIG. 23

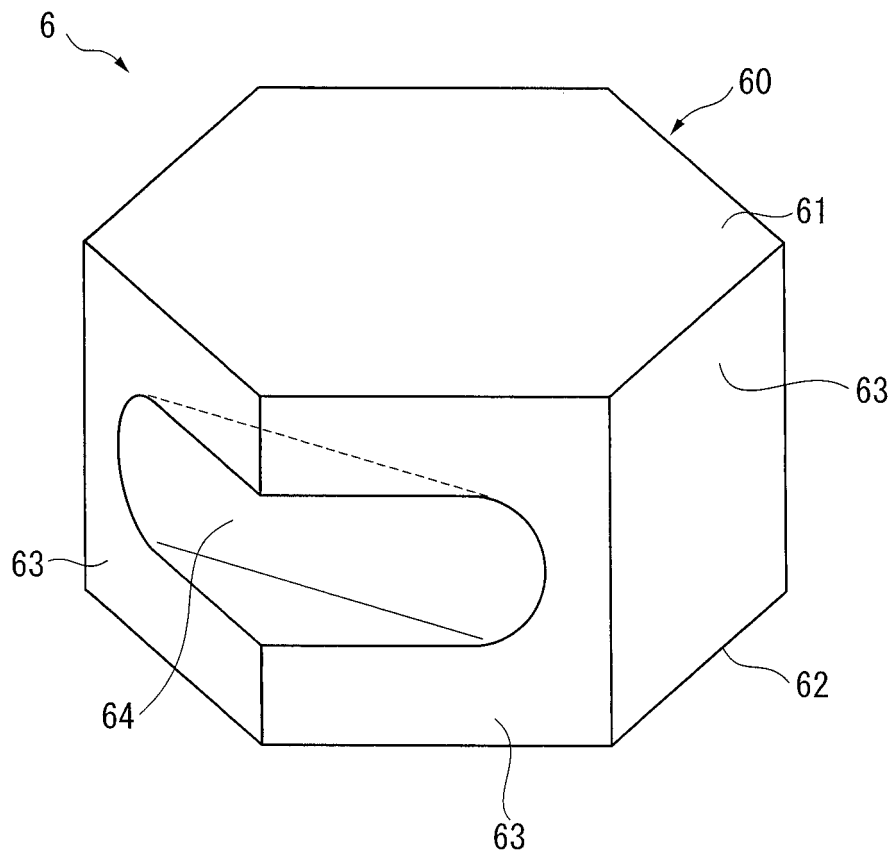


FIG. 24

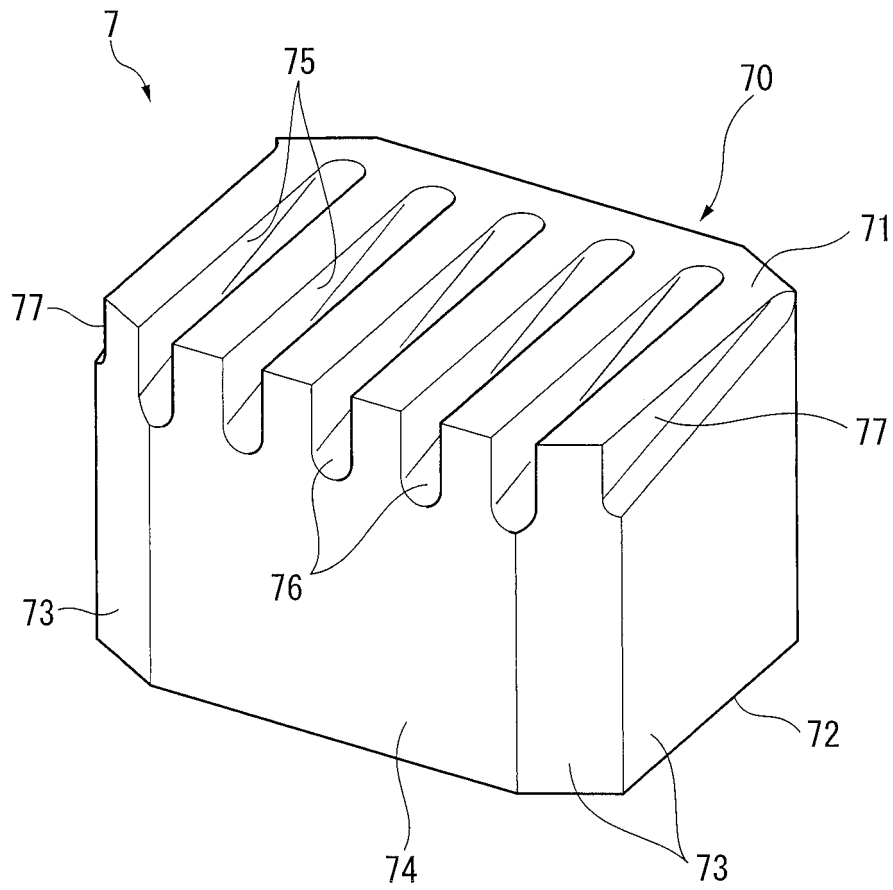


FIG. 25

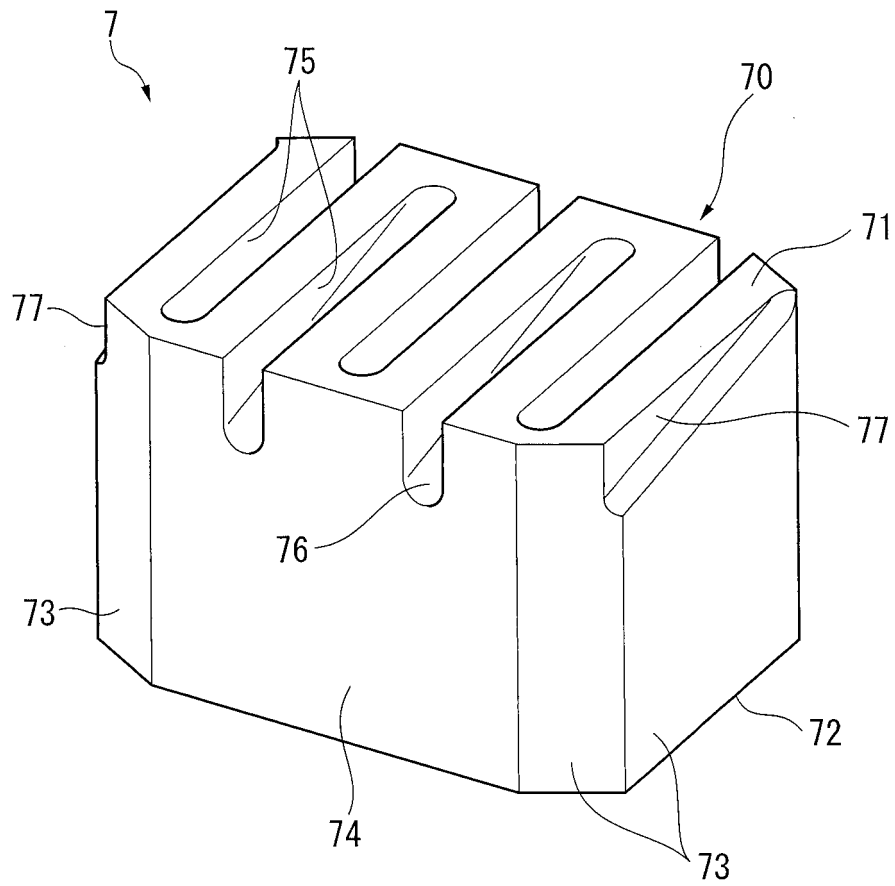


FIG. 26

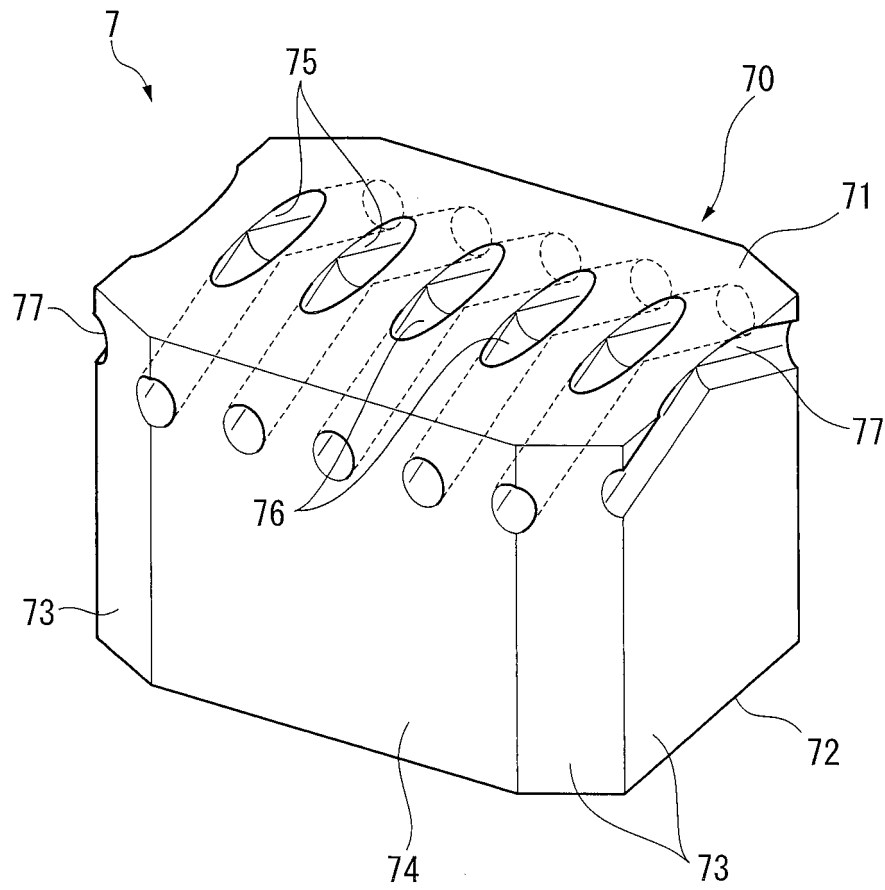


FIG. 27

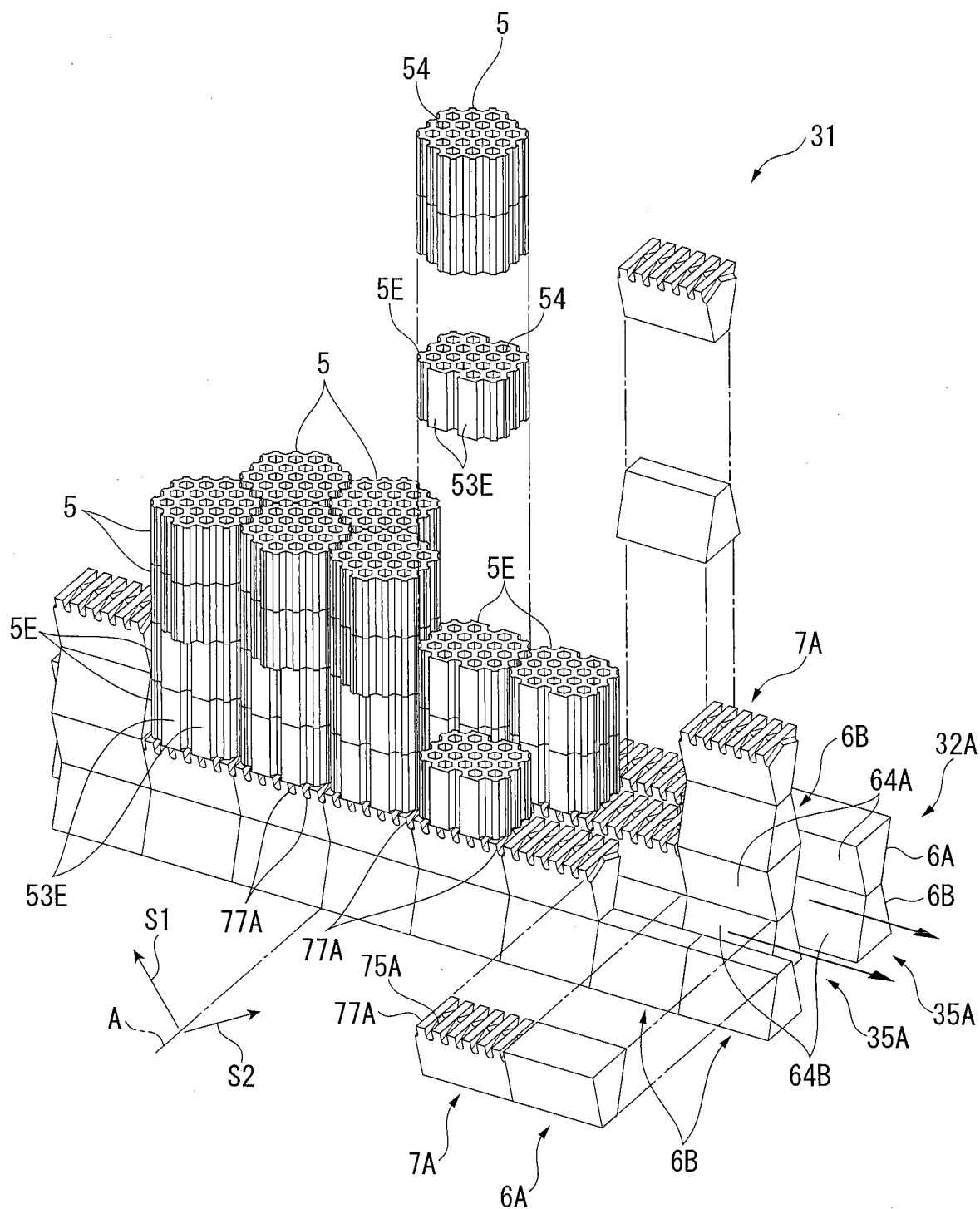


FIG. 28

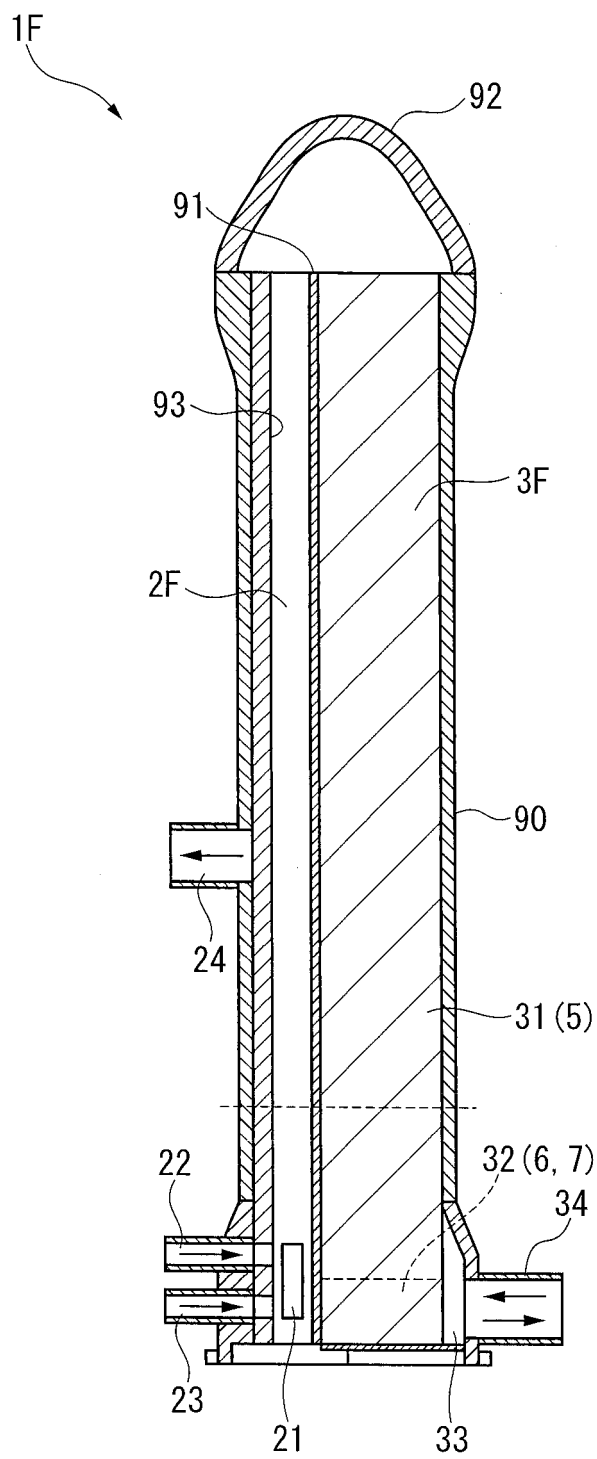


FIG. 29

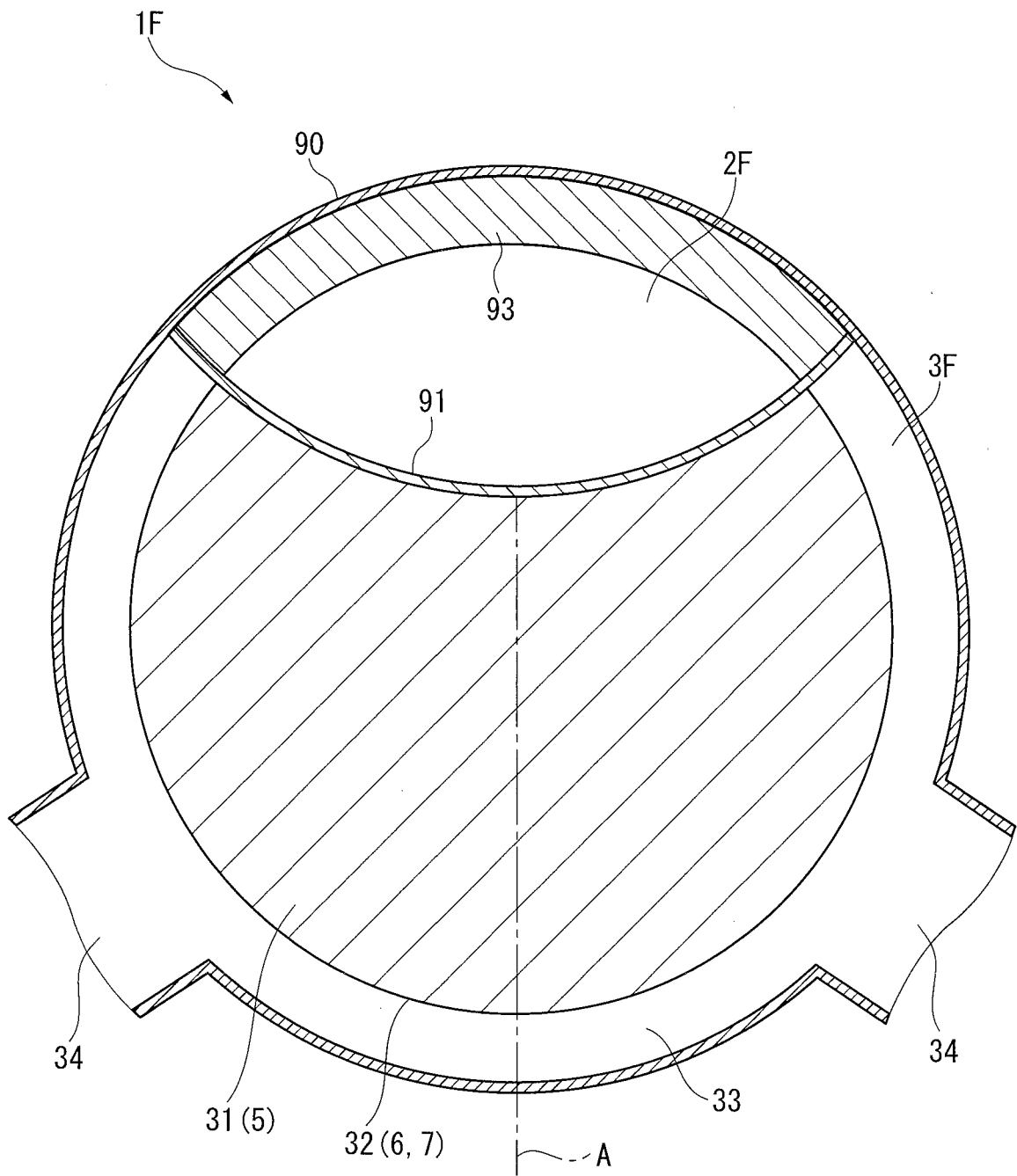


FIG. 30

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/057003

A. CLASSIFICATION OF SUBJECT MATTER

C21B9/04(2006.01)i, F27D1/14(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C21B9/04, C21B9/02, C21B9/06, F27D1/14, F27D1/04

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 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 35649/1992 (Laid-open No. 85837/1993) (Ishikawajima-Harima Heavy Industries Co., Ltd.), 19 November 1993 (19.11.1993), fig. 1 to 6; paragraphs [0011] to [0031] (Family: none)	1-18
A	JP 58-110608 A (Kawasaki Steel Corp.), 01 July 1983 (01.07.1983), fig. 1 to 6; page 2, lower left column, line 9 to page 4, upper left column, line 14 (Family: none)	1-18

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 ☐ See patent family annex.

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Date of the actual completion of the international search
02 April 2015 (02.04.15)Date of mailing of the international search report
14 April 2015 (14.04.15)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/057003

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 49-016606 A (Nippon Steel Corp.), 14 February 1974 (14.02.1974), fig. 1 to 4; page 1, lower right column, line 17 to page 3, upper left column, line 18 (Family: none)	1-18
A	JP 62-083413 A (Sumitomo Metal Industries, Ltd.), 16 April 1987 (16.04.1987), fig. 1 to 2; page 2, upper right column, line 17 to page 3, lower left column, line 2 (Family: none)	1-18
A	JP 61-177306 A (Nissin Refrigeration & Engineering Ltd.), 09 August 1986 (09.08.1986), fig. 1 to 5; page 2, upper right column, line 2 to page 4, upper left column, line 14 (Family: none)	1-18

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4216777 B [0012]
- JP 2563087 A [0012]