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(71) Applicant: **Korea Hydro & Nuclear Power Co., Ltd Gyeongju-si, Gyeongsangbuk-do 38120 (KR)**

(72) Inventors:
• **SONG, Kyu Min Daejeon 34101 (KR)**

• **KWON, Hyuk Chul Daejeon 34101 (KR)**
• **LEE, Kyunghee Daejeon 34101 (KR)**
• **KIM, Yongsoo Gyeongju-si Gyeongsangbuk-do 38120 (KR)**
• **KWON, Kyungsik Gyeongju-si Gyeongsangbuk-do 38120 (KR)**
• **KIM, Chaseop Gyeongju-si Gyeongsangbuk-do 38120 (KR)**
• **PARK, Yonggun Gyeongju-si Gyeongsangbuk-do 38120 (KR)**

(74) Representative: **De Vries & Metman Overschiestraat 180 1062 XK Amsterdam (NL)**

(54) **REPLACEABLE CATALYST TOWER**

(57) The present invention relates to a catalyst tower used in the step of removing and recovering certain radioactive substances during a radioactive waste treatment process applied in a nuclear power plant, and in particular to a catalyst tower with a design improvement in the structure thereof, comprising a tower-type outer frame, a support installed at the bottom of the outer frame, a plurality of catalyst packings stacked one after the other on the support, and a disperser disposed at the upper or lower side of the catalyst packings, and being equipped with a pull-out cartridge having the catalyst packings stacked one after the other therein and forming an opening that is in communication with the outside,

wherein the pull-out cartridge is drawn out when the catalyst packings are pulled out for the maintenance thereof, such that the plurality of the stacked catalyst packings are pulled out together in a stacked state inside the pull-out cartridge. The objective of the present invention is to provide a replaceable catalyst tower which, by having a structure that enables the replacement process of the catalyst packings to be carried out remotely and quickly, promotes the safety of the operator and further improves the process efficiency in the process of dismantling the catalyst tower and replacing the content thereof.

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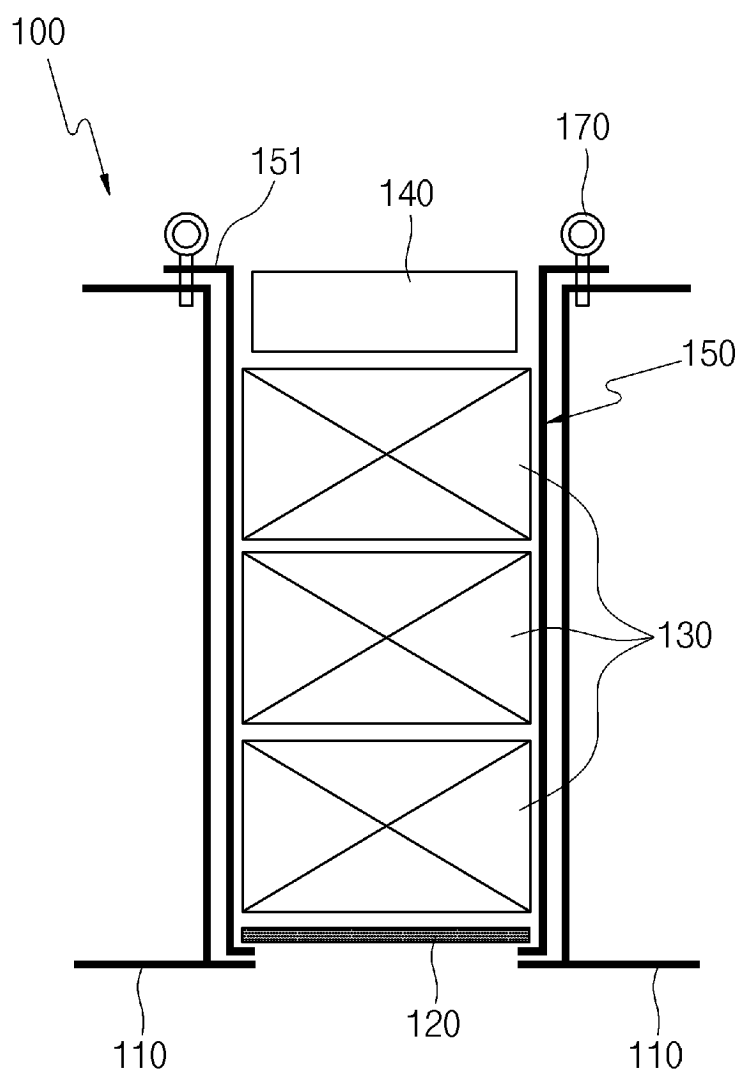


FIG. 2

Description

Technical Field

[0001] The present disclosure relates to a catalyst tower used in a process of removing and recovering a specific radioactive material during a radioactive waste treatment process applied in a nuclear power plant. More particularly, the present disclosure relates to a catalyst tower with a design improvement in the structure thereof.

Background Art

[0002] In a radioactive waste treatment process of a nuclear power plant, a catalytic exchange reaction process may be applied in order to remove a specific radioactive material (for example, tritium and so on) contained in a liquid phase by converting the specific radioactive material into a gas phase. Generally, since a gas-liquid exchange reaction is not easily realized, a catalyst tower in which a catalyst composed of platinum (Pt) and so on is applied and a packing having a structure widening an exchange reaction area is applied is used. At this time, the performance of the catalyst is reduced due to various factors such as aging or accumulation of impurities due to long-term operation, and therefore periodic or irregular replacement is required to be performed.

[0003] However, setting of a conventional catalyst tower 10 is performed such that a catalyst packing 13 is directly loaded inside an outer frame 11 and an internal structure is assembled or dismantled at the site.

[0004] More specifically, as illustrated in FIG. 1(a), the conventional catalyst tower 10 includes the outer frame 11, a support 12, the catalyst packing 13, a disperser 14, an inner frame 11b, and a collector container 19. Furthermore, the catalyst packing 13 is embedded in the inner frame 11b and is also mounted in a space between the outer frame 11 and the collector container 19. Alternatively, as described in FIG. 1(b), all catalyst packings 13 are stacked and directly embedded inside the outer frame 11.

[0005] Therefore, conventionally, mounting of the conventional catalyst tower 10 is performed such that the catalyst packings 13 are directly loaded and the internal structure is assembled at the site, and dismantling of the conventional catalyst tower 10 is performed such that the catalyst packings 13 are pulled out one by one at the site in the opposite order, so that a large space for performing the work on the site is required and a large amount of work time is required.

[0006] Particularly, in a place such as nuclear facilities, when a radioactive material is handled or when a worker is exposed to the radioactive material during operating the nuclear facilities, in addition to space and time issues, there is a problem that it is difficult to prevent the worker from being exposed to radiation during replacing or dismantling of the internal structure of the catalyst tower 10.

[Document of Related Art]

[0007] Korean Patent Application Publication No. 10-2021-0154115 (published on December 20, 2021)

Disclosure

Technical Problem

[0008] Accordingly, the present disclosure has been made keeping in mind the above problems occurring in the related art, and an objective of the present disclosure is to provide a replaceable catalyst tower having a structure capable of remotely or quickly performing a replacement process of a catalyst packing inside the catalyst tower, thereby being capable of securing the safety of a worker and further increasing the process efficiency during a process of dismantling the catalyst tower and a process of replacing contents in the catalyst tower.

Technical Solution

[0009] In order to achieve the objective of the present disclosure, there is provided a replaceable catalyst tower including: a outer frame formed of a rigid member, the outer frame having an open upper portion and an open lower portion; a support provided on the lower portion of the outer frame; a plurality of catalyst packings sequentially stacked on an upper portion of the support; and a disperser disposed on an upper portion or a lower portion of the catalyst packings, and a pull-out cartridge in which the plurality of catalyst packings is sequentially stacked and which has an opening that is in communication with outside, wherein the pull-out cartridge can be pulled out together with the plurality of the stacked catalyst packings for maintenance.

[0010] Here, preferably, the pull-out cartridge may be having an upper flange extended outward and having a predetermined area, and a bottom surface of the upper flange may be supported on an upper end of the upper portion of the outer frame, so that the pull-out cartridge capable of being conveniently pulled out.

[0011] At this time, preferably, an upper portion of the pull-out cartridge may be open and a lower portion of the pull-out cartridge may have a window that is in communication with the outside, so that the plurality of catalyst packings stacked inside the pull-out cartridge may perform a catalytic action in a state in which the plurality of catalyst packings is stacked inside the pull-out cartridge.

[0012] In this situation, preferably, the support and the catalyst packing may be formed larger than an area of the window, so that the support and the catalyst packing may be stably stacked inside the pull-out cartridge.

[0013] Particularly, preferably, the replaceable catalyst tower may further include a sealing container having a volume capable of immediately accommodating the pull-out cartridge that is pulled out together with the catalyst packing so as to prevent radiation from leaking to a

surrounding environment from the catalyst packing when the catalyst packing is pulled out from the outer frame together with the pull-out cartridge.

[0014] In addition, preferably, the replaceable catalyst may further include a fastening member mounted such that the fastening member penetrates both the upper flange and the outer frame so that the pull-out cartridge is fixed when the pull-out cartridge is supported in the outer frame, and wherein the fastening member may be manufactured such that an upper end of the fastening member exposed to the upper portion of the outer frame is formed in a ring shape, so that fastening or dismantling of the fastening member may be conveniently performed remotely by rotating the fastening member by using a remote apparatus which has a hook shape and which passes through the ring shape.

Advantageous Effects

[0015] Since the catalyst tower according to the present disclosure has a structure in which the process of replacing the catalyst packing inside the catalyst tower is capable of being remotely and quickly performed, there is an effect that the safety of a worker is secured and the process efficiency is further increased during the process of dismantling the catalyst tower and the process of replacing the contents in the catalyst tower.

Description of Drawings

[0016]

FIG. 1(a) and FIG. 1(b) are conceptual views illustrating two conventional catalyst towers.

FIG. 2 is a conceptual view illustrating a catalyst tower according to the present disclosure.

FIG. 3 is an exploded view of FIG. 2.

FIG. 4 is a conceptual view illustrating an additional embodiment in FIG. 2.

FIG. 5 is a conceptual view sequentially illustrating a process of dismantling the catalyst tower according to the present disclosure.

Mode for Invention

[0017] Specific structures and functions stated in the following embodiments of the present disclosure are exemplified to illustrate embodiments according to the spirit of the present disclosure and the embodiments according to the spirit of the present disclosure can be achieved in various ways. Furthermore, the present disclosure should not be construed as being limited to the following embodiments and should be construed as including all changes, equivalents, and replacements included in the spirit and scope of the present disclosure.

[0018] Hereinafter, the present disclosure will be described in detail with reference to the accompanying drawings.

[0019] As illustrated in FIG. 2, a replaceable catalyst tower 100 includes an outer frame 110, a support 120, a catalyst packing 130, a disperser 140, and a pull-out cartridge 150.

[0020] As illustrated in FIG. 1(a) and FIG. 1(b), the outer frame 110 is a tower-type structure formed in a column shape that forms the external appearance of a conventional catalyst tower 10.

[0021] Here, since the shape or the structure of the outer frame 110 is not different from an outer frame 11 that configures the conventional catalyst tower 10 illustrated in FIG. 1(a) and FIG. 1(b), the shape or the structure of the outer frame 110 is not specifically limited.

[0022] The support 120 is mounted on a lower portion of the catalyst packing 130 that will be described later, and serves to support the catalyst packing 130.

[0023] The catalyst packing 130 performs an action of an exchange reaction using a catalyst so that a specific radioactive substance (for example, tritium and so on) contained in a liquid phase is capable of being moved to a gas phase.

[0024] The disperser 140 performs an action of preventing channeling of a liquid that is coming down from an upper portion of the disperser 140 and of evenly dispersing the liquid in the catalyst packing 130.

[0025] The pull-out cartridge 150 is a configuration introduced in the replaceable catalyst tower 100 according to the present disclosure, and is a container-type structure having a predetermined volume so that the catalyst packings 130 are capable of being sequentially stacked inside the structure. In addition, as illustrated in FIG. 2, an opening that is in communication with connected to the outside at both upper and lower portions of the replaceable catalyst tower 100.

[0026] Therefore, even in a state in which the cartridge packing 130 is mounted inside the pull-out cartridge 150, when the pull-out cartridge 150 is mounted in the outer frame 110, the cartridge packing 130 may perform an original catalytic action.

[0027] In addition, when the catalyst packing 130 is pulled out for maintenance of the catalyst packing 130, the pull-out cartridge 150 is pulled out, so that the plurality of stacked catalyst packings 130 is capable of being pulled out together with the pull-out cartridge 150 while being in a state in which the plurality of stacked catalyst packings 130 is stacked inside the pull-out cartridge 150.

[0028] Therefore, in a situation in which the catalyst packings 130 are mounted, when the pull-out cartridge 150 in which the cartridge packings 130 are stacked is mounted, there is an effect that the catalyst packings 130 are mounted together with the pull-out cartridge 150, and an additional dismantling process is not required when the catalyst packings 130 are dismantled for maintenance.

[0029] Therefore, a problem of a risk of a worker being exposed to radiation from a catalyst packing 13 during a process of dismantling the conventional catalyst tower 10 may be prevented, and a process of mounting and dis-

mantling the catalyst tower 100 may be performed significantly quickly and conveniently.

[0030] More specifically, as illustrated in FIG. 2, a structure allowing the pull-out cartridge 150 to be conveniently mounted in the catalyst tower 100 has a shape in which the pull-out cartridge 150 extends toward outside of the side surface of the pull-out cartridge 150, and an upper flange 151 having a predetermined area is formed on the pull-out cartridge 150, so that the pull-out cartridge 150 may be mounted such that the pull-out cartridge 150 is capable of being conveniently pulled out since the bottom surface of the upper flange 151 is supported on the upper portion of the upper end of the outer frame 110.

[0031] In this situation, as illustrated in FIG. 2, a fastening member 170 mounted such that the fastening member 170 penetrates both the upper flange 151 and the outer frame 110 so that the pull-out cartridge 150 is capable of being fixed when the pull-out cartridge 150 is supported in the outer frame 110 may be further provided.

[0032] Particularly, here, the fastening member 170 is manufactured such that the upper end of the fastening member 170 exposed to the upper portion of the outer frame 110 is formed in a ring shape, so that fastening or dismantling of the fastening member 170 may be conveniently performed remotely by rotating the fastening member 170 by using a remote apparatus (not illustrated) which has a hook shape and which passes through the ring shape.

[0033] In this situation, an eye bolt may be representatively adopted as the fastening member 170 in which the upper end of the fastening member 170 is formed in the ring shape. In a situation in which the eye bolt is adopted as the fastening member 170, when the pull-out cartridge 150 is to be pulled out from the catalyst tower 100, the eye bolt may be dismantled when a hook of an a stick-type apparatus (not illustrated) having the hook mounted on the distal end of the stick-type apparatus is caught in the eye bolt and the stick-type apparatus is rotated remotely during the process of dismantling the fastening member 170, so that an unmanned remote apparatus for disassembling may be simplified (not illustrated).

[0034] In addition, as described above, the upper portion of the pull-out cartridge 150 is open and the lower portion of the pull-out cartridge 150 has a window in communication with the outside as illustrated in FIG. 2 and FIG. 3, the plurality of catalyst packings 130 stacked inside the pull-out cartridge 150 may perform the catalytic action while being in a state in which the plurality of catalyst packings 130 is stacked inside the pull-out cartridge 150.

[0035] In this situation, since the area of the bottom surface of each of the support 120 and the catalyst packing 130 is formed larger than the area of the window, the support 120 and the catalyst packing 130 may be stably stacked inside the pull-out cartridge and the catalyst packing 130 may smoothly perform the catalytic

action without the risk of falling of the support 120 and the catalyst packing 130 through the window.

[0036] In addition, since the upper flange 151 is widely formed with the predetermined area, at least two catalyst towers 100 may be connected in series in a vertical direction as illustrated in FIG. 4. In this situation, the catalytic effect may be further increased.

[0037] Therefore, by the upper flange 151, the pull-out cartridge 150 may be conveniently mounted and also may function as a stable support for a series connection for enhancing the catalyst performance.

[0038] Meanwhile, as illustrated in the rightmost drawing in FIG. 5, a sealing container 180 having a volume capable of immediately accommodating the pull-out cartridge 150 that is pulled out together with the catalyst packing 130 so as to prevent radiation from leaking from the catalyst packing 130 while the catalyst packing 130 is pulled out from the outer frame 110 together with the pull-out cartridge 150 may be further provided.

[0039] In the conventional catalyst tower 10 as illustrated in FIG. 1, when the catalyst packing 13 is to be stored in the sealing container 180 the same as illustrated in the rightmost drawing in FIG. 5 in order to prevent radiation exposure from the catalyst packing 13 that has finished the catalytic action, a certain level of radiation exposure may occur during sequentially loading each catalyst packing 13 into the sealing container 180, so that the safety of the worker is a concern and a considerable amount of time of the work process may be required.

[0040] However, in the replaceable catalyst tower 100 according to the present disclosure, when the pull-out cartridge 150 is pulled-out and then loaded into the sealing container 180, all catalyst packings 130 may be stored in the sealing container 180 together with the pull-out cartridge 150. Therefore, radiation exposure during the process of moving the catalyst packings 130 to the sealing container 180 may be minimized, and the process of moving the catalyst packings 130 to the sealing container 180 may be performed significantly quickly and conveniently.

[0041] The specific embodiment of the present disclosure is described in detail above. However, the present disclosure is not limited to the specific embodiment. It would be apparent to a person of ordinary skill in the art that various modifications to the present disclosure are possible within the scope of the technical idea of the present disclosure.

[Description of Reference Numerals]

[0042]

10, 100: Catalyst tower 11, 110: Outer frame
11b: Inner frame 12, 120: Support
13, 130: Catalyst packing 14, 140: Disperser
19: Collector container 150: Pull-out cartridge
151: Upper flange 160: Gasket
170: Fastening member 180: Sealing container

181: Cover

Claims

1. A replaceable catalyst tower comprising:

a outer frame formed of a rigid member, the outer frame having an open upper portion and an open lower portion; 5

a support provided on the lower portion of the outer frame; 10

a plurality of catalyst packings sequentially stacked on an upper portion of the support; and

a disperser disposed on an upper portion or a lower portion of the catalyst packings, and 15

a pull-out cartridge in which the plurality of catalyst packings is sequentially stacked and which has an opening that is in communication with outside, 20

wherein the pull-out cartridge can be pulled out together with the plurality of the stacked catalyst packings for maintenance.

2. The replaceable catalyst tower of claim 1, wherein the pull-out is having an upper flange extended outward and having a predetermined area, and a bottom surface of the upper flange is supported on an upper end of the upper portion of the outer frame, so that the pull-out cartridge capable of being conveniently pulled out. 25 30

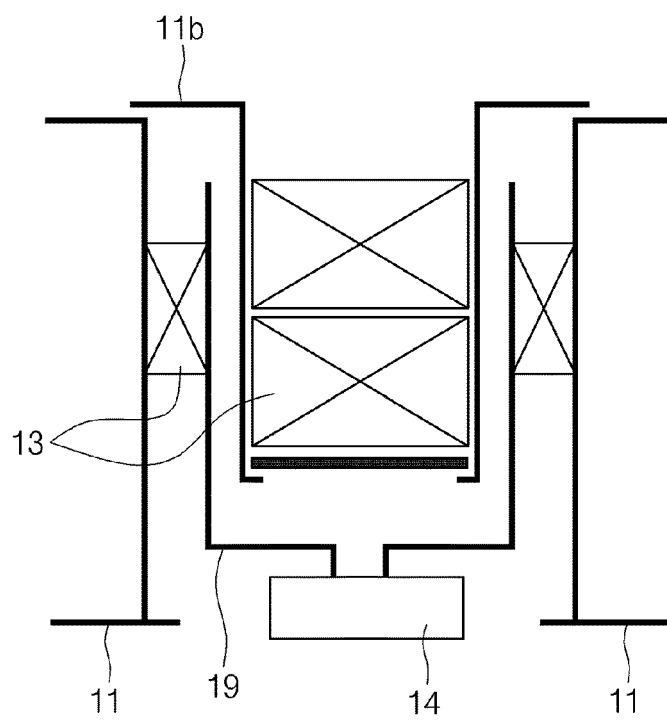
3. The replaceable catalyst tower of claim 2, wherein an upper portion of the pull-out cartridge is open and a lower portion of the pull-out cartridge has a window that is in communication with the outside, so that the plurality of catalyst packings stacked inside the pull-out cartridge is capable of performing a catalytic action in a state in which the plurality of catalyst packings is stacked inside the pull-out cartridge. 35 40

4. The replaceable catalyst tower of claim 3, wherein the support and the catalyst packing are formed larger than an area of the window, so that the support and the catalyst packing are stably stacked inside the pull-out cartridge. 45

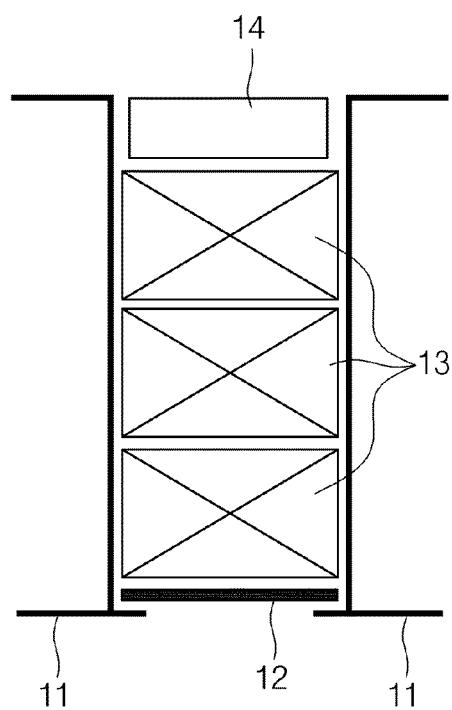
5. The replaceable catalyst tower of claim 4, further comprising a sealing container having a volume capable of immediately accommodating the pull-out cartridge that is pulled out together with the catalyst packing so as to prevent radiation from leaking to a surrounding environment from the catalyst packing when the catalyst packing is pulled out from the outer frame together with the pull-out cartridge. 50 55

6. The replaceable catalyst tower of claim 2, further

comprising a fastening member mounted such that the fastening member penetrates both the upper flange and the outer frame so that the pull-out cartridge is fixed when the pull-out cartridge is supported in the outer frame, and wherein the fastening member is manufactured such that an upper end of the fastening member exposed to the upper portion of the outer frame is formed in a ring shape, so that fastening or dismantling of the fastening member is capable of being conveniently performed remotely by rotating the fastening member by using a remote apparatus which has a hook shape and which passes through the ring shape.



(a)



(b)

FIG. 1

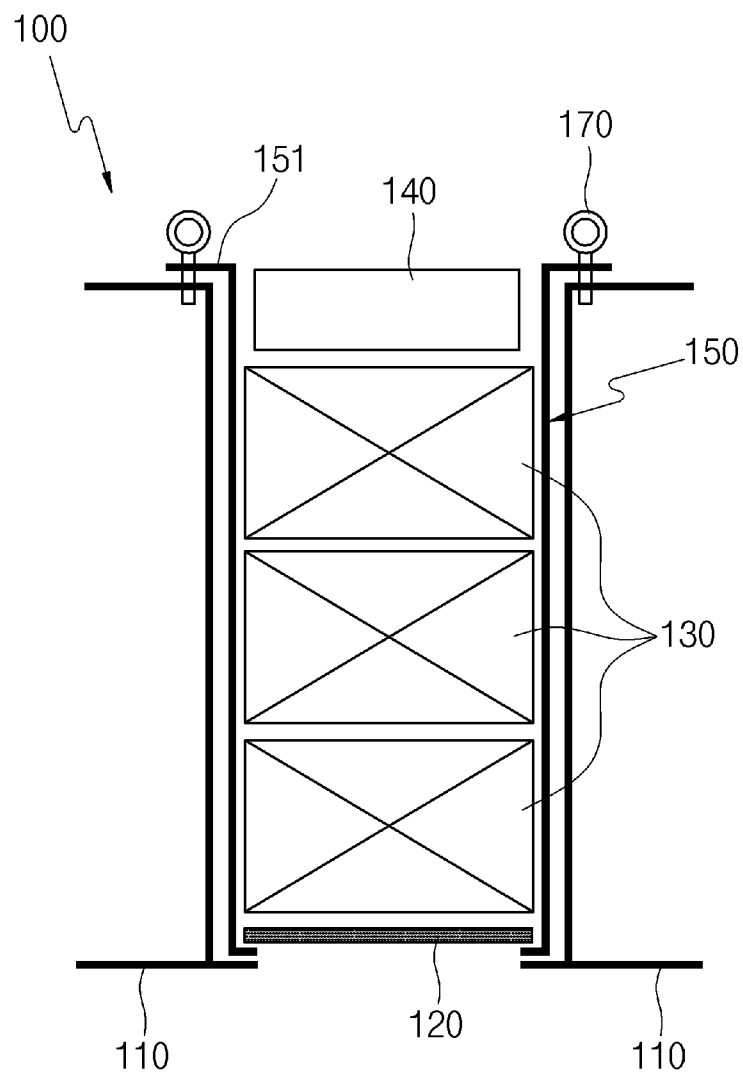


FIG. 2

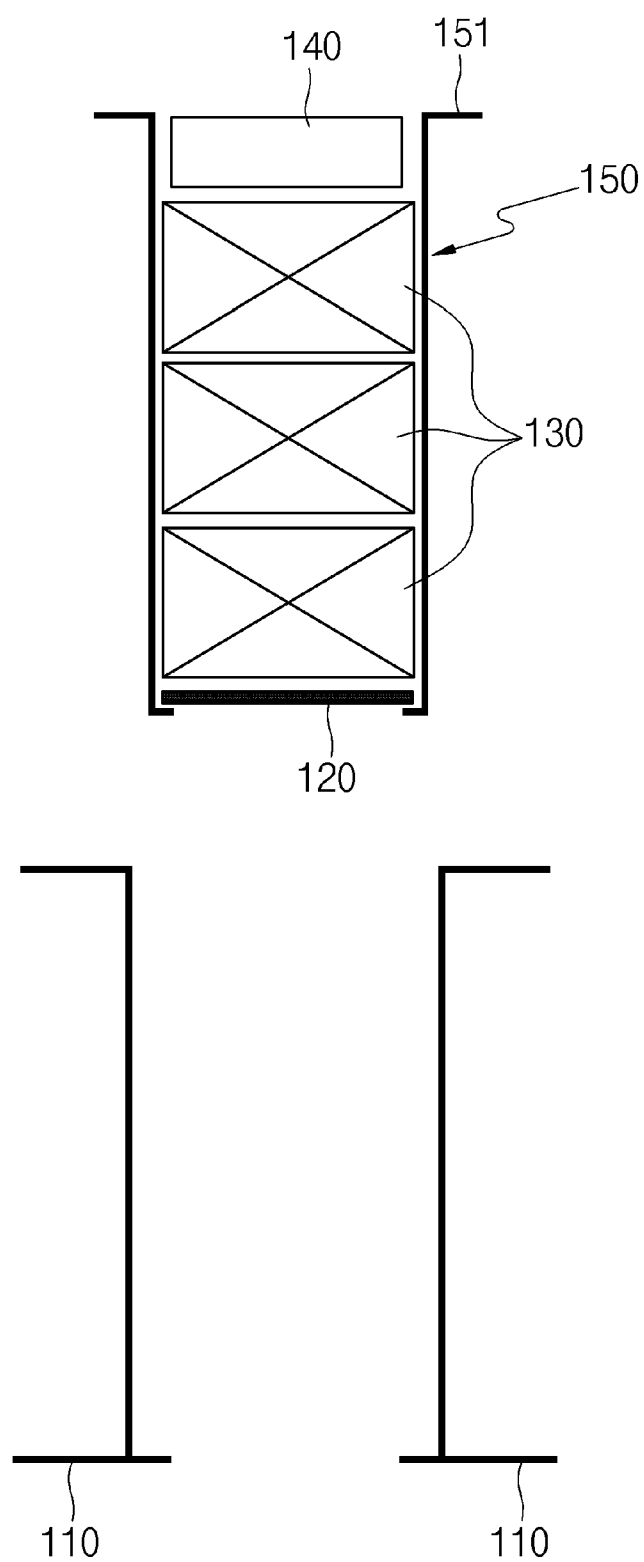


FIG. 3

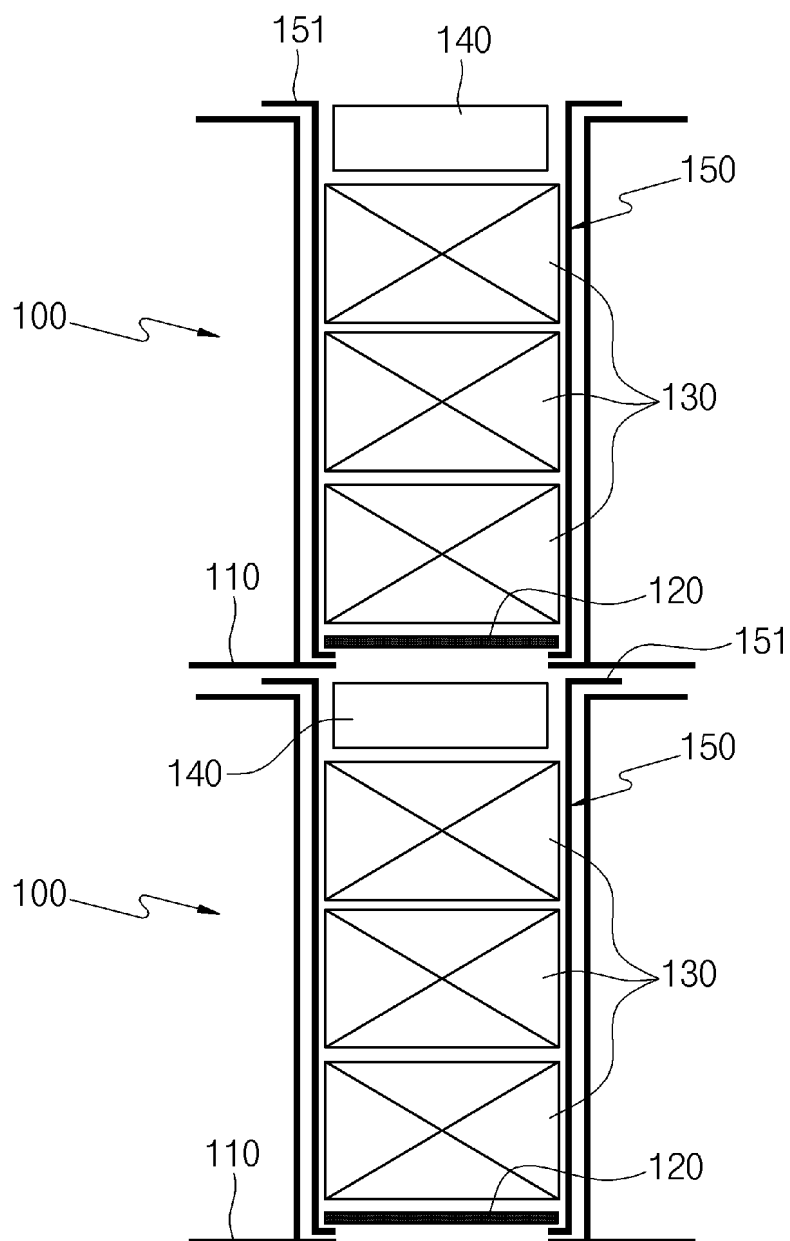


FIG. 4

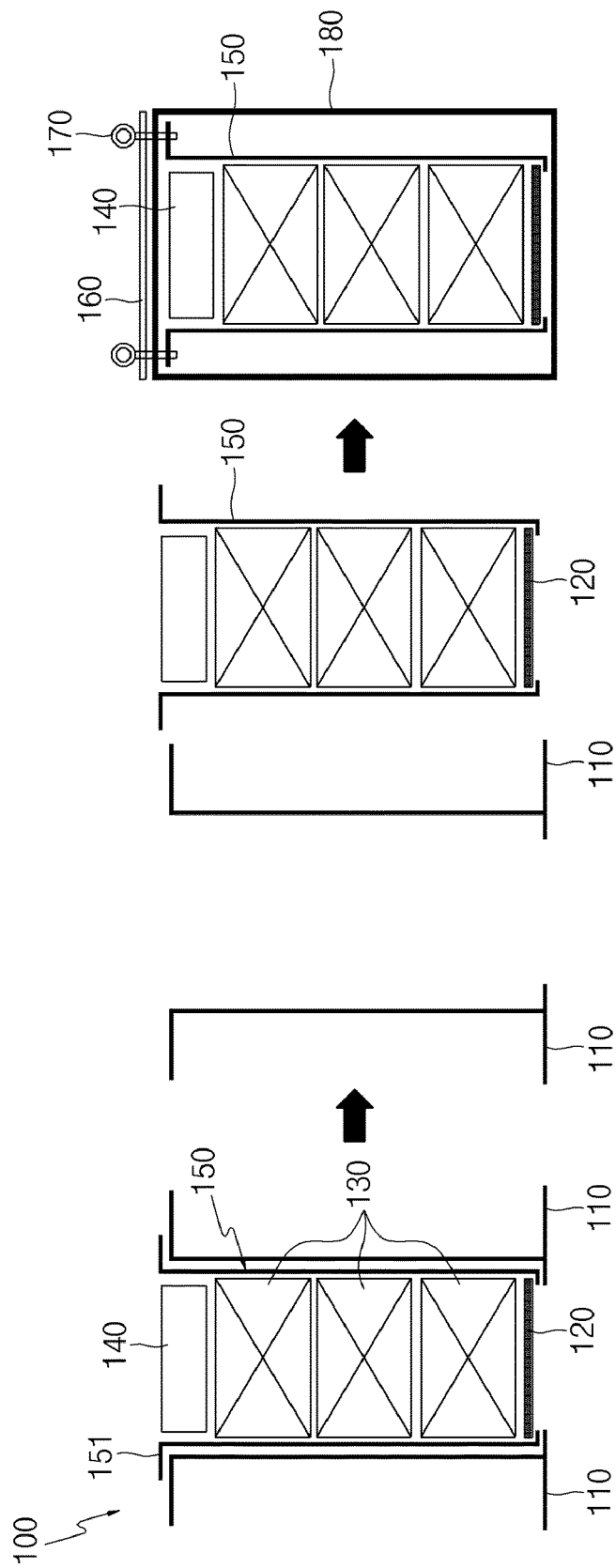


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2023/000446

A. CLASSIFICATION OF SUBJECT MATTER

G21F 9/06(2006.01)j

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)

G21F 9/06(2006.01); B01D 39/14(2006.01); B01D 39/20(2006.01); B01D 53/94(2006.01); B01D 59/30(2006.01); F01N 3/28(2006.01); G21F 7/06(2006.01); G21F 9/00(2006.01); G21F 9/36(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 촉매(catalyst), 교체형(replaceable), 카트리지(cartridge), 패킹(packing)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-1999-0080570 A (KOREA ELECTRIC POWER CORPORATION) 15 November 1999 (1999-11-15) See paragraphs [0014]-[0024]; claim 1; and figures 1-3.	1-6
Y	JP 2005-246301 A (KAWASAKI HEAVY IND. LTD.) 15 September 2005 (2005-09-15) See paragraphs [0058]-[0072]; and figures 1-7.	1-6
Y	KR 10-2015-0012510 A (KOREA ATOMIC ENERGY RESEARCH INSTITUTE) 04 February 2015 (2015-02-04) See paragraph [0015]; and figure 1.	5
Y	JP 2017-142263 A (KANAFLEX CORPORATION) 17 August 2017 (2017-08-17) See paragraphs [0045]-[0047]; and figures 5-7.	6
A	KR 10-2015-0107385 A (HYUNDAI MATERIALS CORPORATION) 23 September 2015 (2015-09-23) See entire document.	1-6

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

* Special categories of cited documents:

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“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

22 May 2023

Date of mailing of the international search report

22 May 2023

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon Building 4, 189 Cheongsang-ro, Seo-gu, Daejeon 35208

Facsimile No. +82-42-481-8578

Authorized officer

Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/000446

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
KR	10-1999-0080570	A	15 November 1999	KR	10-0251066	B1	15 April 2000
JP	2005-246301	A	15 September 2005	None			
KR	10-2015-0012510	A	04 February 2015	KR	10-1529777	B1	30 June 2015
JP	2017-142263	A	17 August 2017	JP	2014-044201	A	13 March 2014
KR	10-2015-0107385	A	23 September 2015	KR	10-1582964	B1	06 January 2016

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 1020210154115 [0007]