(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 388 634 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.10.2018 Bulletin 2018/42

(21) Application number: **17192813.8**

(22) Date of filing: **25.09.2017**

(51) Int Cl.:
F01D 5/30 *(2006.01)* ***F01D 5/32*** *(2006.01)*
F01D 11/00 *(2006.01)*

(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 MD

(30) Priority: **12.04.2017 KR 20170047337**

(71) Applicant: **Doosan Heavy Industries & Construction Co., Ltd.**
Seongsan-gu
Changwon, Gyeongnam 642-792 (KR)

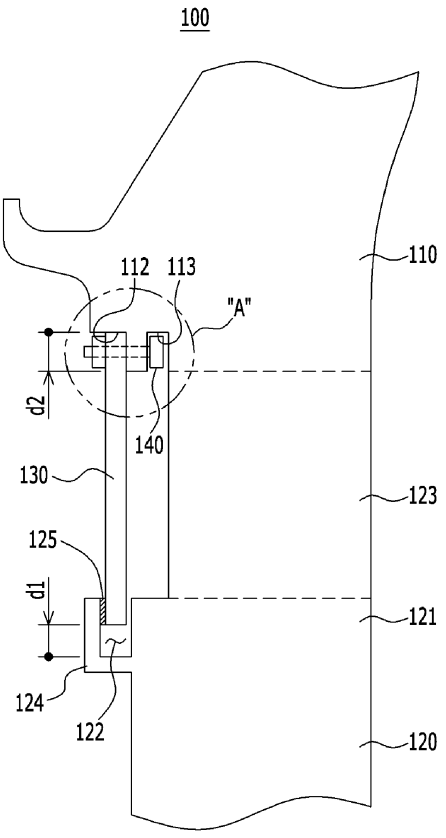
(72) Inventors:
- **JUNG, Sungchul**
  34049 Daejeon (KR)
- **HAM, Dongwoo**
  51674 Gyeongsangnam-do (KR)

(74) Representative: **Ter Meer Steinmeister & Partner Patentanwälte mbB**
Nymphenburger Straße 4
80335 München (DE)

(54) GAS TURBINE BLADE ASSEMBLY HAVING RETAINER ASSEMBLING STRUCTURE, AND GAS TURBINE HAVING SAME

(57) A gas turbine blade assembly, which is as an assembly provided with a plurality of gas turbine blades on an outer circumferential surface of a rotating disk along a circumferential direction to be spaced apart from each other at predetermined intervals, includes: a retainer insertion hole provided in a blade-fixing end, and depressed by a predetermined depth to correspond to a lower end of a retainer; a retainer coupler provided at a lower end of each of the gas turbine blades, and depressed by a predetermined depth to correspond to an upper end of the retainer; and a coupling member coupled at a location adjacent to the retainer coupler to couple the retainer and each of the gas turbine blades together.

Fig. 3



EP 3 388 634 A1

Description

[0001] The present application claims priority to Korean Patent Application No. 10-2017-0047337, filed April 12, 2017.

BACKGROUND

[0002] The present disclosure relates generally to a gas turbine blade assembly having retainer assembling structure, and a gas turbine having the same. More particularly, the present disclosure relates to a gas turbine blade assembly having a structure capable of being easily disassembled and assembled and achieving sealing, and a gas turbine having the same.

[0003] Generally, a turbine is a mechanical device that obtains torque by impulsive force or reaction force using flow of compressible fluid such as steam or gas. It is called as a steam turbine when steam is used and a gas turbine when combustion gas is used.

[0004] A thermodynamic cycle of the gas turbine is the Brayton Cycle, which is as follows: a compressor for sucking and boosting air from the atmosphere and supplying combustion air to a combustor; the combustor for mixing and combusting the introduced compressed air with fuel to produce a combustion gas of high energy; and a turbine for converting the high temperature and high pressure combustion gas from the combustor into mechanical energy when the combustion gas expands to apply the impulsive and reaction force to rotating blades of the turbine.

[0005] The mechanical energy obtained from the turbine is supplied to the compressor (approximately 60% of the total turbine power) required to compress the air and the remainder is used to drive a generator to produce power.

[0006] The operation principle of the gas turbine is the following four steps: compression, heating, expansion, and heat dissipation. That is, the air in the atmosphere is sucked first, compressed by the compressor, then sent to the combustor to generate high temperature and high pressure gas to operate the turbine, and the exhaust gas is discharged to the atmosphere.

[0007] Among components of the conventional gas turbine, a retainer is provided adjacent to a blade and a rotating disk to form a sealing and flow path for the cooling air flowing from the rotating disk.

[0008] FIGS. 1 and 2 are sectional views partially showing a gas turbine blade assembly provided with a retainer according to the related art.

[0009] According to the related art, various methods are used to assemble the retainer.

[0010] According to the related art, as shown in FIGS. 1 and 2, the retainer is locked to the blade or to a side of the rotating disk by force fitting or by using a coupling member.

[0011] However, the above method is problematic in that a large number of members to be prepared for assembly are required, and the assembling process and the disassembling process are very complicated, whereby work efficiency is remarkably low.

[0012] The retainer according to the related art is problematic in that it requires a very complicated structure to form the cooling gas sealing and the flow path, so it is not easy to manufacture and install.

[0013] Accordingly, a new technique for a gas turbine blade assembly is needed.

[0014] The foregoing is intended merely to aid in the understanding of the background of the present disclosure, and does not mean that the present disclosure falls within the purview of the background art.

BRIEF SUMMARY OF THE DISCLOSURE

[0015] The object is solved by the features of the independent claims. Preferred embodiments are given in the dependent claims.

[0016] According to some aspects of the present disclosure, there is provided a gas turbine blade assembly, as an assembly provided with a plurality of gas turbine blades on an outer circumferential surface of a rotating disk along a circumferential direction to be spaced apart from each other at predetermined intervals, the gas turbine blade assembly including: a retainer insertion hole provided in a blade-fixing end, and depressed by a predetermined depth to correspond to a lower end of a retainer; a retainer coupler provided at a lower end of each of the gas turbine blades, and depressed by a predetermined depth to correspond to an upper end of the retainer; and a coupling member coupled at a location adjacent to the retainer coupler to couple the retainer and each of the gas turbine blades together.

[0017] In an embodiment of the present disclosure, each of the gas turbine blades may be mounted to a dovetail slot provided on the outer circumferential surface of the rotating disk along the circumferential direction, and the gas turbine blades may be aligned in an axial direction by the retainer.

[0018] In an embodiment of the present disclosure, the rotating disk may be provided with a protruding structure protruding by a predetermined length at a side thereof, and the protruding structure may be provided with the retainer insertion hole at an upper surface thereof.

[0019] In the above case, the protruding structure may be provided along the circumferential direction of the rotating disk, and may be in an annular shape in a plan view.

[0020] In an embodiment of the present disclosure, the retainer insertion hole may be provided with a bearing surface on an inner surface thereof to be in surface contact with the retainer.

[0021] In an embodiment of the present disclosure, the lower end of the retainer may be spaced apart from a bottom surface of the retainer insertion hole at a predetermined distance, and the depth of the retainer coupler may be equal to or less than the distance between the lower end of the retainer and the bottom surface of the

retainer insertion hole.

[0022] In an embodiment of the present disclosure, the gas turbine blade assembly may further include a coupling member insertion hole provided at a location adjacent to the retainer coupler at the lower end of each of the gas turbine blades, and depressed to correspond to the coupling member.

[0023] In the above case, a slot groove in a shape corresponding to an outer surface of the coupling member may be provided between the coupling member insertion hole and the retainer coupler.

[0024] Further, the slot groove may be provided in a direction parallel to an extension direction of the retainer.

[0025] In an embodiment of the present disclosure, the coupling member may be in a bolt structure, with a bolt head thereof inserted into the coupling member insertion hole, and with a threaded part thereof protruding by a predetermined length in a direction toward the retainer coupler to be engaged with the upper end of the retainer.

[0026] Further, the threaded part of the coupling member may be engaged with a nut to couple the coupling member and the retainer together, and an outer surface of the nut may be formed as curved surface continuous with an outer surface of the lower end of each of the gas turbine blades.

[0027] In an embodiment of the present disclosure, the lower end of each of the gas turbine blades may be provided with a sealing protrusion protruding by a predetermined length in a direction toward a neighboring gas turbine blade.

[0028] In an embodiment of the present disclosure, the upper end of the retainer may be provided with an auxiliary sealing protrusion protruding by a predetermined length to correspond to the sealing protrusion.

[0029] In an embodiment of the present disclosure, a side surface of the retainer may be provided with a support protrusion extending in a direction toward the lower end of each of the gas turbine blades and having a contact surface corresponding to a side surface of each of the gas turbine blades, with a sealing wire mounted to the contact surface of the support protrusion.

[0030] Further, according to some aspects of the present disclosure, there is provided a gas turbine having the gas turbine blade assembly. The gas turbine includes a blade assembly provided with a plurality of gas turbine blades on an outer circumferential surface of a rotating disk along a circumferential direction to be spaced apart from each other at predetermined intervals, wherein the blade assembly includes: a retainer insertion hole provided in a blade-fixing end, and depressed by a predetermined depth to correspond to a lower end of a retainer; a retainer coupler provided at a lower end of each of the gas turbine blades, and depressed by a predetermined depth to correspond to an upper end of the retainer; and a coupling member coupled at a location adjacent to the retainer coupler to couple the retainer and each of the gas turbine blades together.

[0031] In an embodiment of the present disclosure, the rotating disk may be provided with a protruding structure protruding by a predetermined length at a side thereof, and the protruding structure may be provided with the retainer insertion hole at an upper surface thereof.

[0032] In an embodiment of the present disclosure, the protruding structure may be provided along the circumferential direction of the rotating disk, and may be in an annular shape in plan view.

[0033] In an embodiment of the present disclosure, the lower end of the retainer may be spaced apart from a bottom surface of the retainer insertion hole at a predetermined distance, and the depth of the retainer coupler may be equal to or less than the distance between the lower end of the retainer and the bottom surface of the retainer insertion hole.

[0034] In an embodiment of the present disclosure, the gas turbine blade assembly may further include a coupling member insertion hole provided at a location adjacent to the retainer coupler at the lower end of each of the gas turbine blades, and depressed to correspond to the coupling member.

[0035] As described above, according to an exemplary gas turbine blade assembly of the present disclosure provided with a retainer insertion hole, a retainer coupler, and a coupling member having predetermined structures, it is possible to provide a gas turbine blade assembly having a structure capable of being easily disassembled and assembled and may achieve complete sealing, and a gas turbine having the same.

[0036] Further, according to an exemplary gas turbine blade assembly of the present disclosure that includes a protruding structure having a predetermined structure is provided at a side of a rotating disk, with the protruding structure provided with the retainer insertion hole at an upper surface thereof, it is possible to facilitate easy assembly and disassembly and possible to achieve complete sealing.

[0037] Further, according to an exemplary gas turbine blade assembly of the present disclosure that includes a retainer insertion hole provided with a bearing surface on an inner surface thereof to be in surface contact with the retainer, it may be possible to achieve complete sealing of the gas turbine blade, the rotating disk, and the retainer.

[0038] Further, according to an exemplary gas turbine blade assembly of the present disclosure in which the lower end of the retainer is spaced apart from a bottom surface of the retainer insertion hole at a predetermined distance, and the depth of the retainer coupler is equal to or less than the distance between the lower end of the retainer and the bottom surface of the retainer insertion hole, assembly and disassembly of the retainer may be performed more easily than the related art.

[0039] Further, according to an exemplary gas turbine blade assembly of the present disclosure that includes a coupling member insertion hole, a coupling member, and a retainer coupler having predetermined structures, it is possible to easily assemble and disassemble the retain-

er, and possible to achieve a stable coupling structure.

[0040] Further, according to an exemplary gas turbine blade assembly of the present disclosure that includes a slot groove in a predetermined shape provided between the coupling member insertion hole and the retainer coupler, and the retainer and the gas turbine blade are coupled together after the coupling member is mounted by using the slot groove, it is possible to perform easy assembly, and possible to achieve a stable coupling structure.

[0041] Further, according to an exemplary gas turbine blade assembly of the present disclosure in which the gas turbine blade is locked by using a nut formed with a curved surface continuous with an outer surface of the lower end of each of the gas turbine blades, it is possible to achieve a stable coupling structure.

[0042] Further, according to an exemplary gas turbine blade assembly of the present disclosure that includes a sealing protrusion, an auxiliary sealing protrusion, a support protrusion, and a sealing wire having predetermined structures, it is possible to provide a structure capable of facilitating easy assembly and disassembly and may achieve complete sealing.

[0043] Further, according to an exemplary gas turbine of the present disclosure that includes a gas turbine blade assembly having a predetermined structure, it is possible to provide a gas turbine having a structure capable of being easily disassembled and assembled and may achieve complete sealing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] The above and other objects, features and other advantages of the present disclosure will be more clearly understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a sectional view partially showing a gas turbine blade assembly provided with a retainer according to the related art;

FIG. 2 is a sectional view partially showing the gas turbine blade assembly provided with the retainer according to the related art;

FIG. 3 is a sectional view partially showing a gas turbine blade assembly according to an embodiment of the present disclosure;

FIG. 4 is a partial enlarged view showing a rotating disk provided with a dovetail slot, to which the gas turbine blade according to the embodiment of the present disclosure is mounted;

FIG. 5 is an enlarged view of area A of FIG. 3;

FIG. 6 is a partial enlarged view showing a slot groove of a retainer shown in FIG. 3;

FIG. 7 is a sectional view partially showing a gas turbine blade assembly according to another embodiment of the present disclosure;

FIG. 8A is schematic view showing disassembly of the retainer of the gas turbine blade according to an embodiment of the present disclosure;

FIG. 8B is schematic view showing disassembly of the retainer of the gas turbine blade according to an embodiment of the present disclosure;

FIG. 8C is schematic view showing disassembly of the retainer of the gas turbine blade according to an embodiment of the present disclosure; and

FIG. 8D is schematic view showing disassembly of the retainer of the gas turbine blade according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0045] Reference will now be made in detail to preferred embodiments of the present disclosure with reference to the accompanying drawings. Before describing, it will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0046] Throughout the specification, when a member is "on" another member, it includes not only when a member is in contact with another member, but also when there is another member between the two members. It will be further understood that the terms "comprise", "include", "have", etc. when used in this specification, specify the presence of stated features, integers, steps, operations, elements, components, and/or combinations of them but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or combinations thereof.

[0047] FIG. 3 is a sectional view partially showing a gas turbine blade assembly according to an embodiment of the present disclosure.

[0048] Referring to FIG. 3, a gas turbine blade assembly 100 according to the embodiment, which is as an assembly provided with a plurality of gas turbine blades 110 on an outer circumferential surface of a rotating disk 120 along a circumferential direction to be spaced apart from each other at predetermined intervals, includes a retainer insertion hole 122, a retainer coupler 112, and a coupling member 140 having predetermined structures, whereby it is possible to provide a gas turbine blade assembly having a structure capable of being easily disassembled and assembled and may achieve complete sealing, and a gas turbine having the same.

[0049] Hereinbelow, each component of the gas turbine blade assembly 100 will be described in detail, with reference to the accompanying drawings.

[0050] FIG. 4 is a partial enlarged view showing a rotating disk provided with a dovetail slot, to which the gas turbine blade according to the embodiment of the present disclosure is mounted; FIG. 5 is an enlarged view of area A of FIG. 3; and FIG. 6 is a partial enlarged view showing a slot groove of a retainer shown in FIG. 3.

[0051] Referring to the above drawings along with FIG. 3, the retainer insertion hole 122 according to the embodiment may be provided at a side of an upper end 121 of the rotating disk, and may be depressed by a predetermined depth to correspond to a lower end of a retainer 130.

[0052] In some cases, as shown in FIG. 3, the rotating disk 120 may be provided with a protruding structure 124 protruding by a predetermined length at a side thereof, and the protruding structure 124 may be provided with the retainer insertion hole 122 at an upper surface thereof.

[0053] Here, the protruding structure 124 may be provided along the circumferential direction of the rotating disk 120, and may be in an annular shape in a plan view.

[0054] Further, the retainer insertion hole 122 may be provided with a bearing surface 125 on an inner surface thereof to be in surface contact with the retainer 130.

[0055] The retainer coupler 112 may be provided at a lower end of each of the gas turbine blades 110, and may be depressed by a predetermined depth to correspond to an upper end of the retainer 130.

[0056] Preferably, the lower end of the retainer 130 is spaced apart from a bottom surface of the retainer insertion hole 122 at a predetermined distance d1, and the depth d2 of the retainer coupler 112 is equal to or less than the distance between the lower end of the retainer 130 and the bottom surface of the retainer insertion hole 122.

[0057] In this case, as shown in FIG. 8, it is very easy to disassemble or assemble the retainer 130. Further, the coupling member 140 may be coupled at a location adjacent to the retainer coupler 112 to couple the retainer 130 and each of the gas turbine blades 110 together.

[0058] As shown in FIG. 4, each of the gas turbine blades 110 according to the embodiment may be mounted to a dovetail slot 123 provided on the outer circumferential surface of the rotating disk 120 along the circumferential direction. Here, the gas turbine blades 110 may be aligned in an axial direction by the retainer 130.

[0059] In some cases, as shown in FIGS. 3 and 5, a coupling member insertion hole 113 may be provided at a location adjacent to the retainer coupler 112 at the lower end of each of the gas turbine blades 110. Here, it is preferred that the coupling member insertion hole 113 be in a shape corresponding to the coupling member 140.

[0060] Further, as shown in FIGS. 5 and 6, a slot groove 114 in a shape corresponding to an outer surface of the coupling member 140 may be provided between the coupling member insertion hole 113 and the retainer coupler 112. Here, it is preferred that the slot groove 114 be provided in a direction parallel to an extension direction of the retainer 130.

[0061] In this case, the coupling member 140 can be easily coupled or separated using the slot groove 114, so that assembly and disassembly of the retainer can be more easily induced.

[0062] Meanwhile, as shown in FIG. 5, the coupling member 140 according to the embodiment, which is in a bolt structure, may include a bolt head 141, and a threaded part 142.

[0063] To be more specific, it is preferred that the bolt head 141 of the coupling member 140 be inserted into the coupling member insertion hole, and the threaded part 142 of the coupling member protrude by a predetermined length in a direction toward the retainer coupler 112 to be engaged with the upper end of the retainer 130.

[0064] Further, the threaded part 142 of the coupling member 140 may be engaged with a nut 143 to couple the coupling member 140 and the retainer 130 together.

[0065] In some cases, as shown in FIG. 5, an outer surface of the nut 143 is formed as a curved surface 145 continuous with an outer surface of the lower end of each of the gas turbine blades 110.

[0066] FIG. 7 is a sectional view partially showing a gas turbine blade assembly according to another embodiment of the present disclosure.

[0067] Referring to FIG. 7, the gas turbine blade assembly 100 according to the embodiment may further include a sealing protrusion 115 that is provided at the lower end of each of the gas turbine blades 110 and protrudes by a predetermined length in a direction toward a neighboring gas turbine blade 110.

[0068] Further, as shown in FIG. 7, the upper end of the retainer 130 may be provided with an auxiliary sealing protrusion 131 protruding by a predetermined length to correspond to the sealing protrusion 115.

[0069] In some cases, a side surface of the retainer 130 may be provided with a support protrusion 132 extending in a direction toward the lower end of each of the gas turbine blades 110 and having a contact surface corresponding to a side surface of each of the gas turbine blades 110.

[0070] Here, it is preferred that a sealing wire 133 be mounted to the contact surface of the support protrusion 132.

[0071] Accordingly, according to the gas turbine blade assembly 100 of the present disclosure, since it is provided with the sealing protrusion 115, the auxiliary sealing protrusion 131, the support protrusion 132, and the sealing wire 133 having predetermined structures, it is possible to provide a structure capable of facilitating easy assembly and disassembly and may achieve complete sealing.

[0072] The present disclosure further provides a gas turbine having the above described gas turbine blade assembly 100, in which, as shown in FIG. 8, it is possible to provide a gas turbine having a structure capable of being easily disassembled and assembled and achieving complete sealing.

[0073] Figure 8A illustrates the gas turbine blade assembly 100 in an assembled state. Figure 8B illustrates the removal of the nut 143 from the coupling member 140 and the displacement of the retainer 130 downwardly into the insertion hole 122. Figure 8C illustrates the removal of the coupling member 140 and the retainer 130.

Figure 8D illustrates the gas turbine blade assembly 100 in a disassembled state. While the present disclosure has been described in conjunction with exemplary embodiments thereof, it is to be understood that the present description does not limit the present disclosure to those exemplary embodiments. On the contrary, the present disclosure covers not only the exemplary embodiments, but also various alternatives, modifications, equivalents and other embodiments that may be included within the scope of the present invention as defined by the appended claims.

[0074] In other words, the present disclosure is not limited to the exemplary embodiments nor to the above description, and those skilled in the art will appreciate that various modifications, additions, and substitutions are possible, without departing from the scope of the disclosure.

Claims

1. A gas turbine blade assembly (100), comprising:

a turbine blade (110) including a retainer coupler (112) provided a first distance from a first end;
a rotating disk (120) including a blade-fixing end and a retainer insertion holed (122) defined in the blade-fixing end, a depth of the retainer insertion hole (122) being at least the first distance;
a retainer (130) sized to be disposed in the retainer insertion hole (122); and
a coupling member (140) disposed at a location proximal to the retainer coupler(112) to couple the retainer (130) and the (110) together.

2. The gas turbine blade assembly (100) of claim 1, wherein
the rotating disk (120) includes a dovetail slot (123) on an outer circumferential surface,
the turbine blade (110) is operable to mount to the dovetail slot (123), and
the turbine blade (110) is aligned in an axial direction by the retainer (130).

3. The gas turbine blade assembly (100) of claim 1 or 2, wherein the rotating disk (120) includes a protruding structure (124) at an upper surface providing the retainer insertion hole (122)

4. The gas turbine blade assembly (100) of claim 3, wherein the protruding structure (124) is disposed along a circumferential direction of the rotating disk (120), and is in an annular shape in a plan view.

5. The gas turbine blade assembly (100) as claimed in any one of the preceding claims, wherein an inner surface of the retainer insertion hole (122) includes a bearing surface (125) operable to contact the retainer (130).

6. The gas turbine blade assembly (100) as claimed in any one of the preceding claims, wherein

a lower end of the retainer (130) is spaced apart from a bottom surface of the retainer insertion hole (122), and
a depth of the retainer coupler (112) is equal to or less than the distance between the lower end of the retainer (130) and the bottom surface of the retainer insertion hole (122).

7. The gas turbine blade assembly (100) as claimed in any one of the preceding claims, further comprising a coupling member insertion hole (113) defined at a location adjacent to the coupling member (140) at the first end of the turbine blade (110).

8. The gas turbine blade assembly (100) of claim 7, wherein a slot groove in a shape corresponding to an outer surface of the coupling member (140) is defined between the coupling member insertion hole (113) and the retainer coupler (112).

9. The gas turbine blade assembly (100) of claim 8, wherein the slot groove is disposed in a direction parallel to an extension direction of the retainer (130).

10. The gas turbine blade assembly (100) of claim 7, wherein the coupling member (140) includes a bolt, a head of the bolt head being disposed proximal to the coupling member insertion hole (113), and a threaded part of the bolt protruding in a direction toward the retainer coupler (112) to engage with the retainer (130).

11. The gas turbine blade assembly (100) of claim 10, wherein

the threaded part of the coupling member (140) is operable to engage with a nut to couple the coupling member (140) and the retainer (130) together, and
an outer surface of the nut includes a curved surface corresponding to an outer surface of an end of the turbine blade (110).

12. The gas turbine blade assembly (100) as claimed in any one of the preceding claims, wherein the first end of the turbine blade (110) includes a sealing protrusion that protrudes toward a neighboring gas turbine blade (110).

13. The gas turbine blade assembly (100) of claim 12, wherein the retainer (130) includes an auxiliary seal-

ing protrusion that protrudes by a length to corresponding to a length of the sealing protrusion.

14. The gas turbine blade assembly (100) as claimed in any one of the preceding claims, wherein

a side surface of the retainer (130) includes a support protrusion extending in a direction toward the first end of the turbine blade (110),
the retainer (130) includes and a contact surface corresponding to a side surface of the turbine blade (110), and
a sealing wire is disposed on the contact surface of the support protrusion.

15. A gas turbine comprising:

a blade assembly (100) including a plurality of gas turbine blades (110) on an outer circumferential surface of a rotating disk (120) along a circumferential direction and spaced apart from each other, wherein the blade assembly (100) includes:

a retainer coupler (112) provided a first distance from a first end of one of the turbine blades (110);
a retainer insertion hole (122) defined in a blade-fixing end of the rotating disk (120), a depth of the retainer insertion hole (122) being at least the first distance;
a retainer (130) sized to be disposed in the retainer insertion hole (122); and
a coupling member (140) disposed at a location proximal to the retainer coupler (112) to couple the retainer (130) and the turbine blade (110) together.

Fig. 1

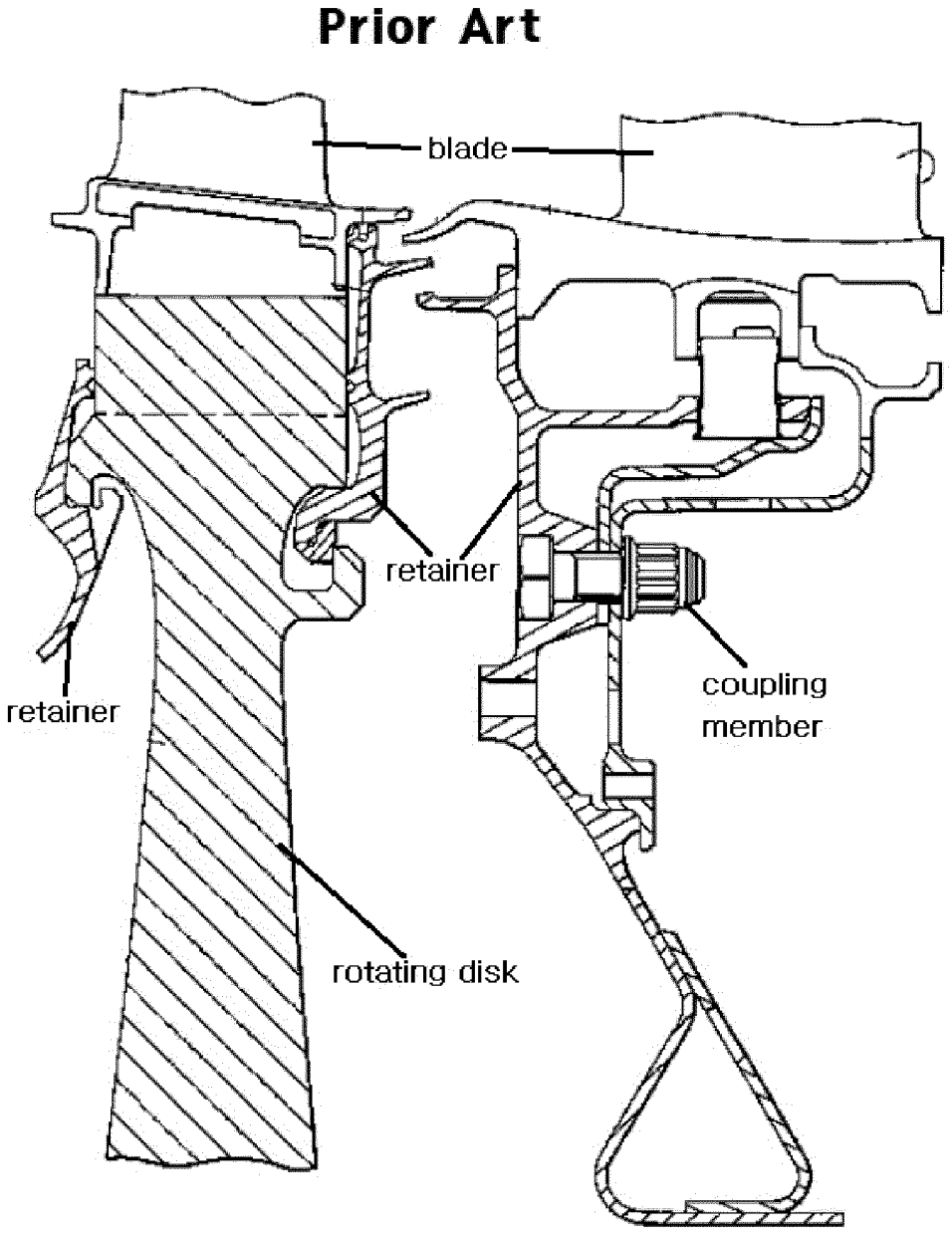

Prior Art
blade
retainer
retainer
coupling
member
rotating disk

Fig. 2

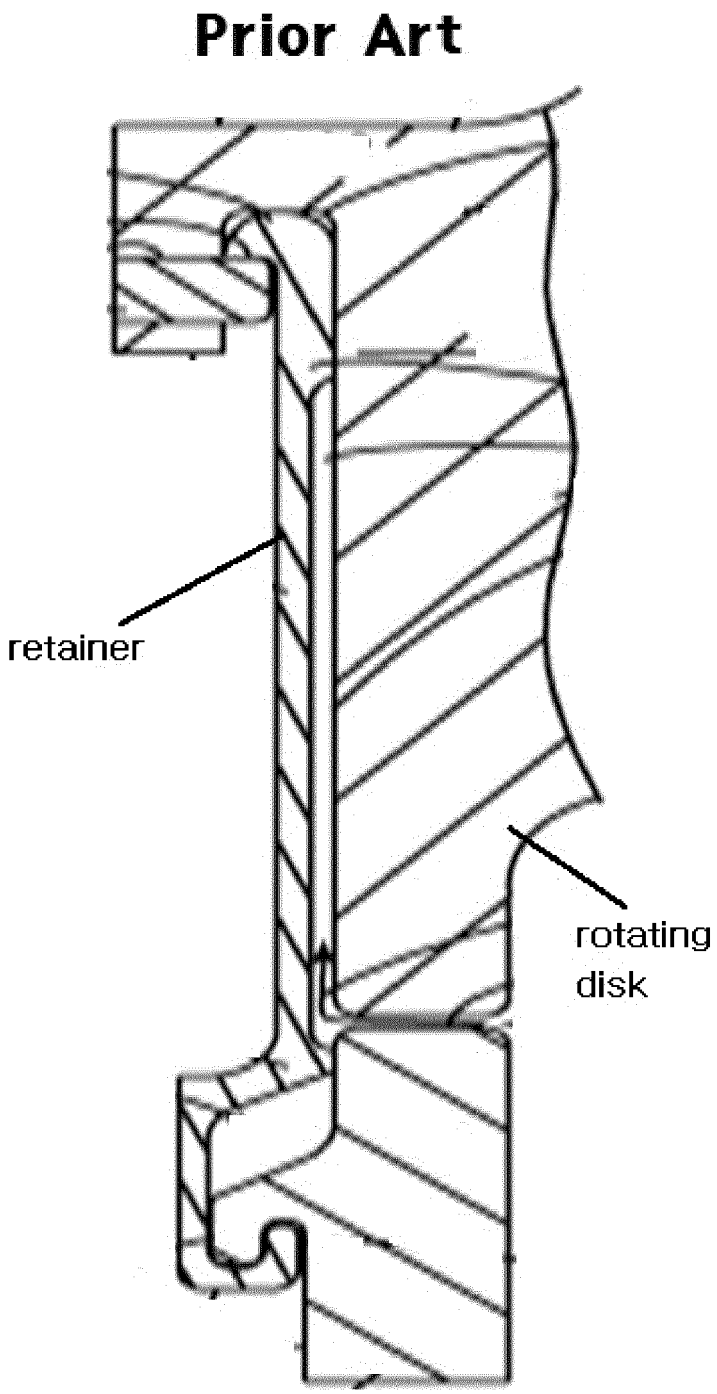


Fig. 3

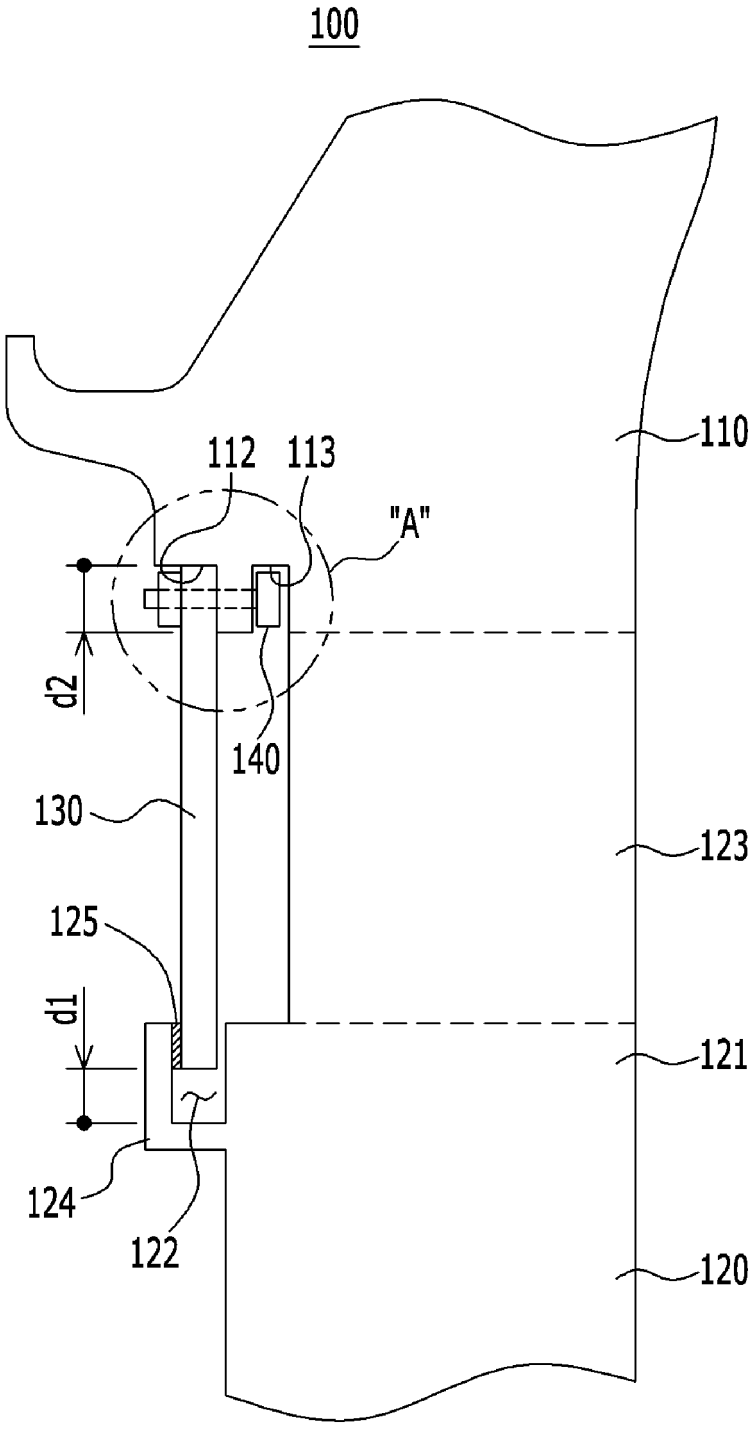


Fig. 4

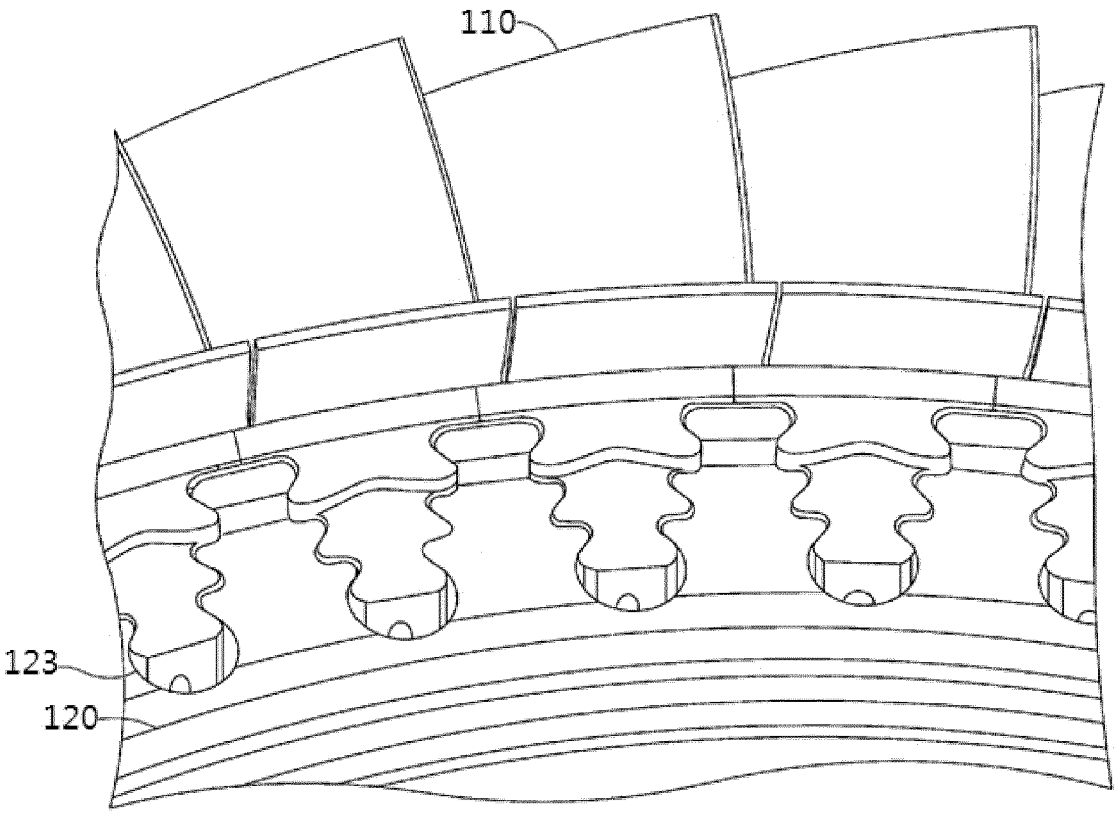


Fig. 5

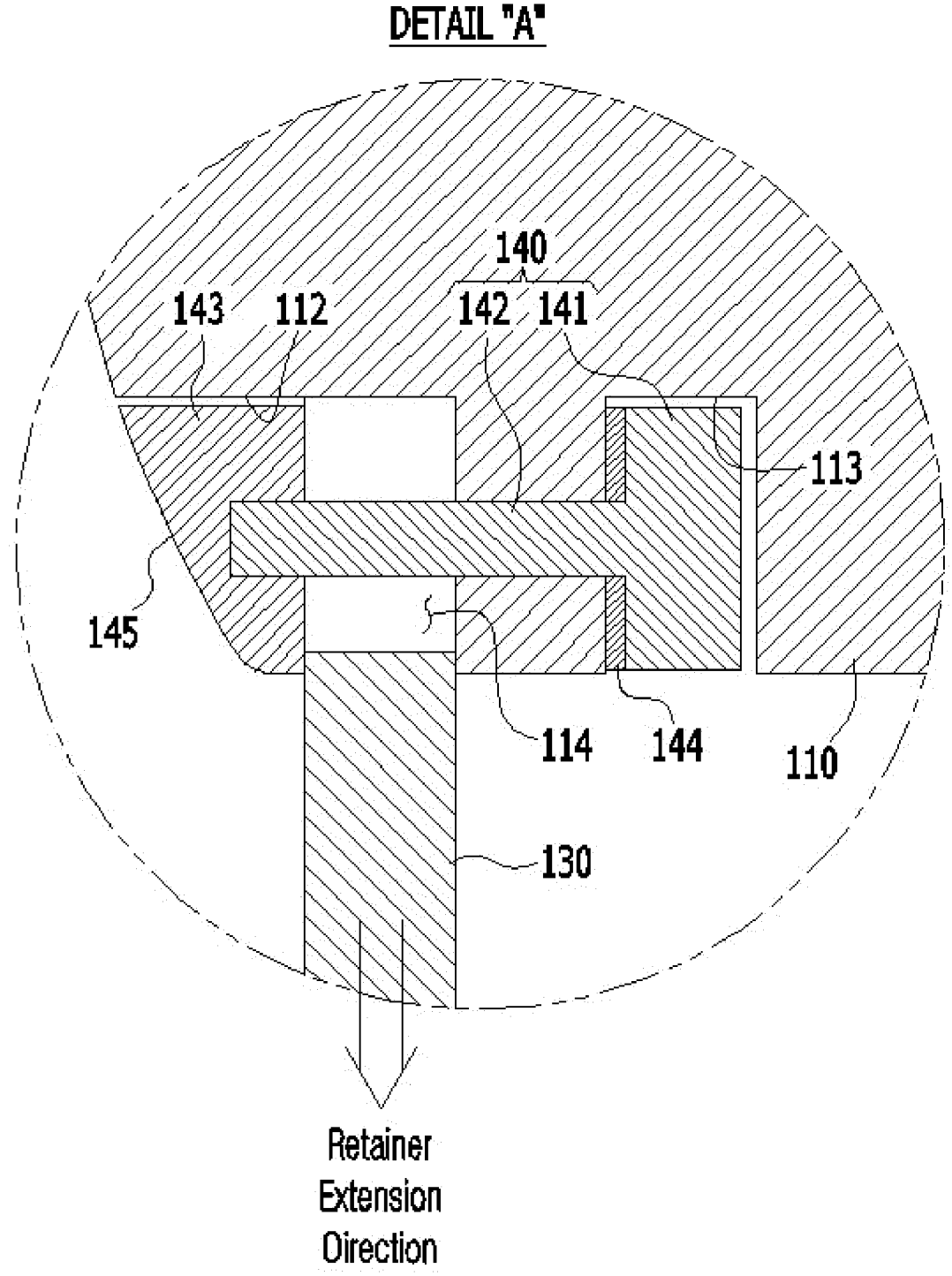

DETAIL "A"
140
143
112
142
141
113
145
114
144
110
130
Retainer
Extension
Direction

Fig. 6

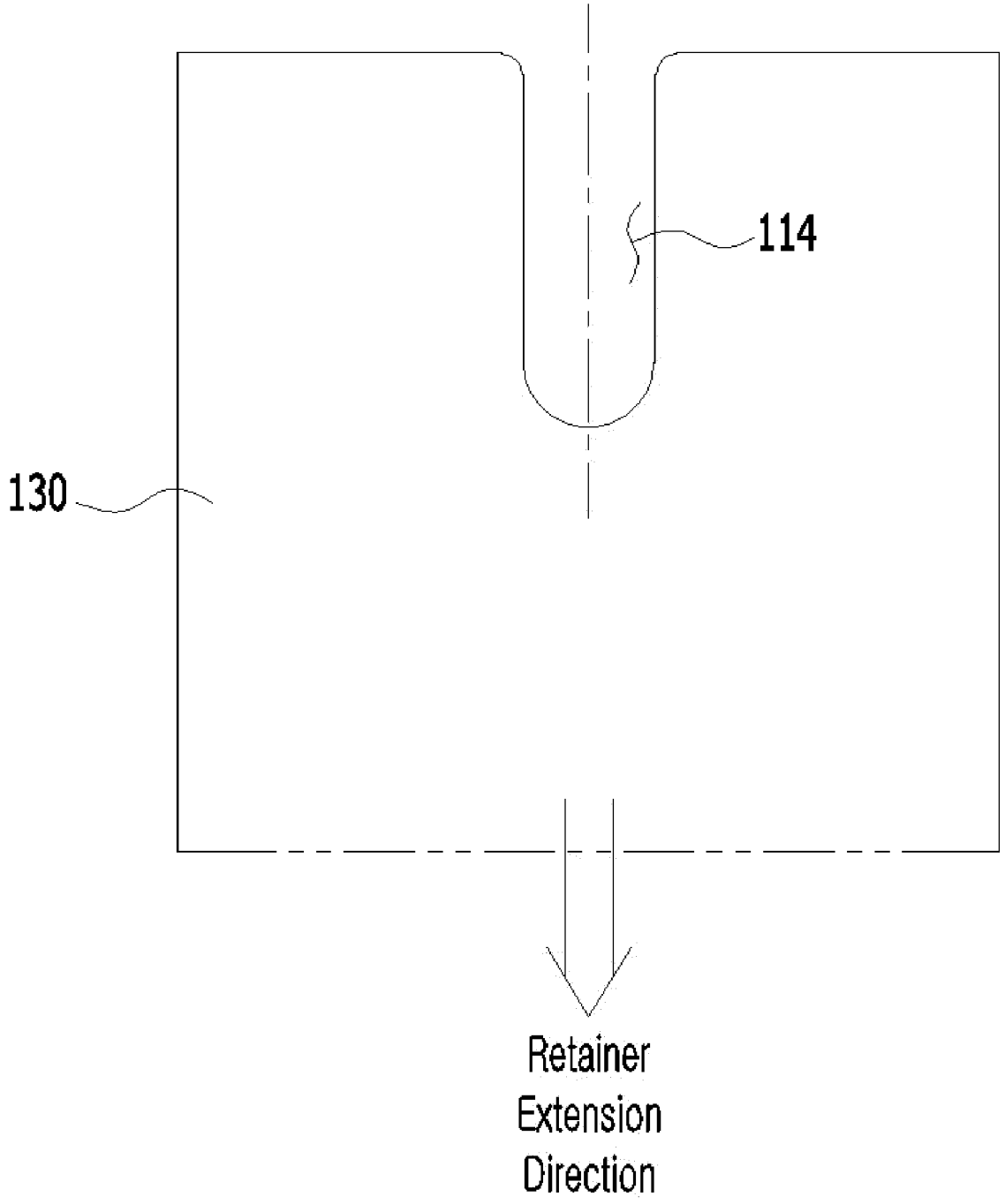


Fig. 7

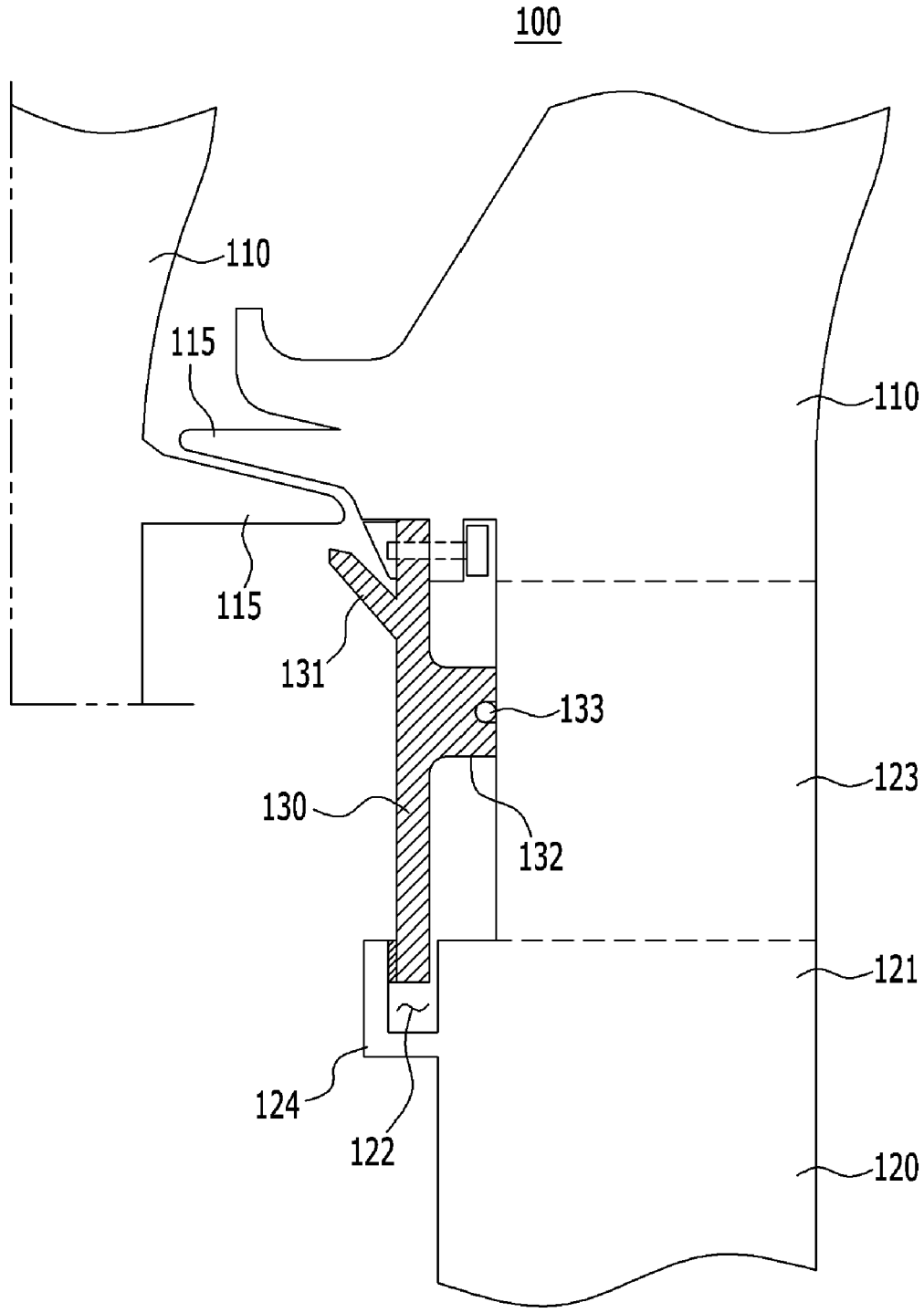


Fig. 8A

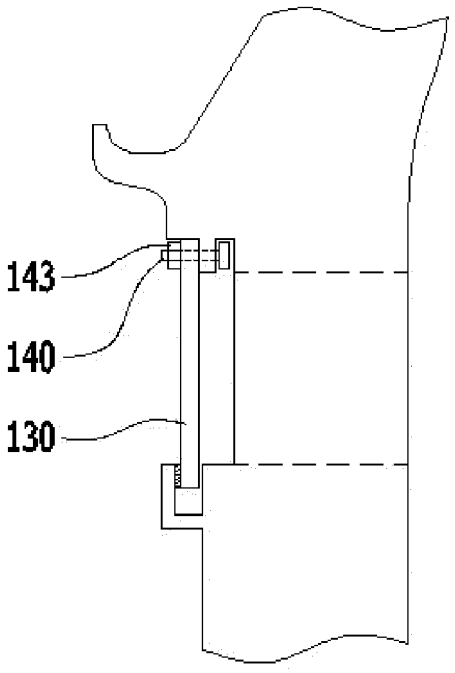


Fig. 8B

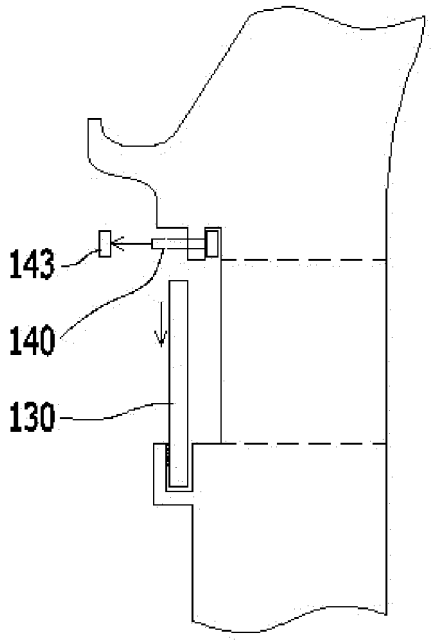


Fig. 8C

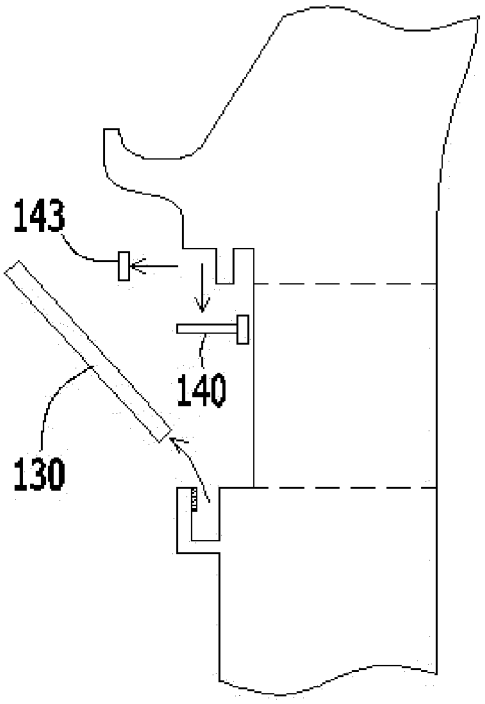
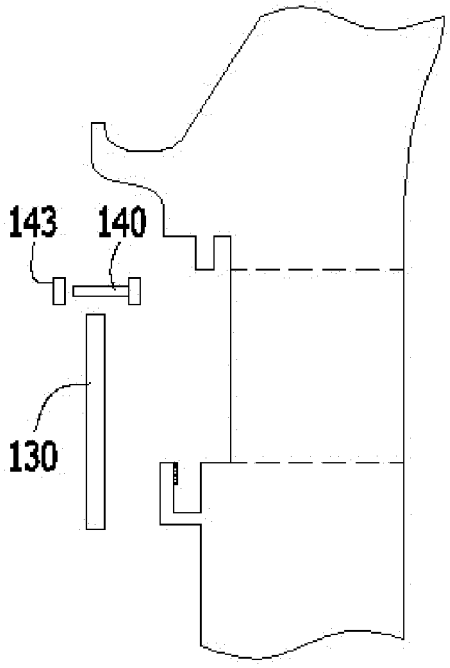


Fig. 8D



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 19 2813

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 853 425 A (SCALZO A ET AL) 10 December 1974 (1974-12-10) * abstract; figures 3,4 * -----	1-15	INV. F01D5/30 F01D5/32 F01D11/00
X	US 2004/062643 A1 (BRAUER JOHN CHRISTOPHER [US] ET AL) 1 April 2004 (2004-04-01) * paragraphs [0015] - [0019]; figures 1,2 * -----	1-15	
X	GB 2 268 979 A (SNECMA [FR]) 26 January 1994 (1994-01-26) * figures 2,7 * -----	1-15	
X	EP 2 662 533 A2 (GEN ELECTRIC [US]) 13 November 2013 (2013-11-13) * abstract; figures 3,4 * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 March 2018	Avramidis, Pavlos

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 19 2813

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-03-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3853425 A	10-12-1974	CA 975301 A	30-09-1975
		CH 584345 A5	31-01-1977
		DE 2440430 A1	13-03-1975
		FR 2243331 A1	04-04-1975
		GB 1449415 A	15-09-1976
		IT 1020433 B	20-12-1977
		JP S5054712 A	14-05-1975
		JP S5228169 B2	25-07-1977
		NL 7411052 A	11-03-1975
		SE 397382 B	31-10-1977
		US 3853425 A	10-12-1974
US 2004062643 A1	01-04-2004	NONE	
GB 2268979 A	26-01-1994	FR 2694046 A1	28-01-1994
		GB 2268979 A	26-01-1994
		US 5320492 A	14-06-1994
EP 2662533 A2	13-11-2013	CN 103388492 A	13-11-2013
		EP 2662533 A2	13-11-2013
		JP 6243623 B2	06-12-2017
		JP 2013234659 A	21-11-2013
		RU 2013120130 A	20-11-2014
		US 2013294927 A1	07-11-2013

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- KR 1020170047337 **[0001]**