(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 September 2012 (07.09.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/117365 A1

(51) International Patent Classification:
F02C 3/10 (2006.01) *F02B 3/02* (2006.01)
F02K 3/06 (2006.01) *F02B 3/06* (2006.01)

(21) International Application Number:
PCT/IB2012/050963

(22) International Filing Date:
1 March 2012 (01.03.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PV 2011-107 2 March 2011 (02.03.2011) CZ

(72) Inventor; and
(71) Applicant : **KREIDL, Frantisek** [CZ/CZ]; U Nove dalnice 726/6, CZ14900 Prague 4 (CZ).

(74) Agent: **REZAC, Petr**; Jihozapdni III 1145/4, CZ14100 Prague (CZ).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

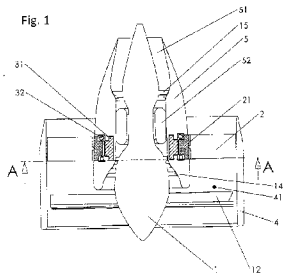
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

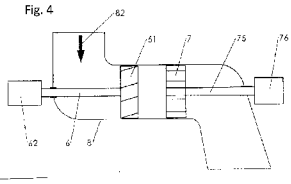
Published:

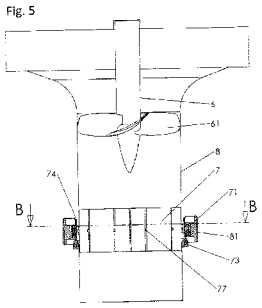
— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: FLUID MACHINE







(57) Abstract: A fluid machine having an impeller (12; 61) with a plurality of blades and including a fluid inlet room and a fluid outlet room wherein an extra blade wheel (2; 7) rotatably mounted independent of the rotation of the impeller (12; 61) is located on the downstream side of the impeller (12; 61) and this extra blade wheel (2; 7) is associated with a device for conversion of the blade wheel kinetic energy into electric or pressure energy. T he impeller is a fan (12) of an air bypass turbojet engine or a runner wheel (61) of a water turbine and the device for conversion of the kinetic energy is an electric generator or a hydraulic pump.

WO 2012/117365 A1

Description

Title of Invention: Fluid machine

Technical Field

[1] The invention relates to a fluid machine having an impeller with a plurality of blades and including a fluid inlet room and a fluid outlet room.

Background Art

[2] One of characteristic features of all fluid machines with an impeller and fluid inlet and outlet room is a whirling motion, also called vortex, of the fluid such as liquid, air or another gas in the outlet room of the machine and continuing downstream the outlet tube exit plane. The whirling motion consisting of a linear and rotational component is caused by rotation of the impeller blade wheel. This phenomena is common to the impeller of a turbine converting the kinetic or pressure water energy to mechanical energy as well as to, for example, a dynamic machine with a blade wheel such as turbo-compressor which compresses gas flowing through the impeller. The whirling motion of the fluid may also have an undesired effect, for example with a jet engine aircraft, where it causes a declination of the exhaust fumes stream from the aircraft longitudinal axis behind the outlet tube exit plane due to a lateral force component of the vortex, what may cause a reduction of the total axial effective engine thrust.

[3] In the prior art certain mechanisms for directing the fluid stream are disclosed. For example US 5261787 describes a device for directing water stream behind a turbine impeller by means of a cone that may be even forcibly rotated in order to reduce water surges and vibration of the turbine.

[4] US 4175640 discloses a system for internal mixing of hot primary exhaust flow with cool fan flow for reducing jet noise in a turbofan engine.

[5] Another solutions for directing the exhaust flow used frequently with the jet engines represents a system of fixed blades placed in fan air passageway behind the fan impeller. The fixed blades shall avoid rotational motion of the air behind the fan impeller and enable to use the axial air flow for directing the nozzle outlet fumes straight forward to avoid the undesired divergence of the exhaust fumes stream.

Disclosure of Invention

Technical Problem

[6] The primary object of the invention is to provide a fluid machine comprising means for exploiting the rotational energy of the whirling motion of the fluid generated behind the impeller.

[7] Another object of the invention is to use such means for directing the fluid flow behind the impeller.

Solution to Problem

Technical Solution

[8] The object of this invention can be achieved by a fluid machine having an impeller with a plurality of blades and including a fluid inlet room and a fluid outlet room where an extra blade wheel rotatably mounted independent of the rotation of the impeller is located on the downstream side of the impeller and this extra blade wheel is associated with a device for conversion of the blade wheel kinetic energy into the electric or pressure energy.

[9] Hereinafter, other advantageous embodiments of the invention are described that develop or specify in more details its essential features but without limiting the scope of the invention.

[10] The extra blade wheel is located at the distance equal to 0.2 up to 2 multiple of the outside diameter of the impeller.

[11] The position of blades of the extra blade wheel with respect to the fluid stream is controlled by an adjusting mechanism.

[12] The device for conversion of the kinetic energy is an electric generator or a hydraulic pump.

[13] The impeller is a fan of an air bypass turbojet engine and the blade of the extra blade wheel are located in the air bypass channel.

[14] The extra blade wheel comprises a hub carrying a rotor of an electric generator and rotatably mounted on a hollow journal fixed to the engine body and including a stator of the electric generator.

[15] The impeller is a runner wheel of a water turbine.

[16] The outer ends of the blades of the extra blade wheel are attached to a watertight sealed ring for receiving a rotor of an electric generator carried in bearings incorporated in a turbine clothing together with a stator of the electric generator.

Advantageous Effects of Invention

Advantageous Effects

[17] The extra blade wheel arranged downstream the impeller enables to acquire additional usable source of kinetic energy, which is susceptible to conversion by conventional methods into electric or pressure energy. Another advantage of the fluid engine according to the invention resides in the possibility to set optimal characteristics of the fluid flow downstream the impeller. Still another advantage is that the flow characteristics may be adjusted interactively by application of a blade adjusting mechanism.

Brief Description of Drawings

Description of Drawings

[18] Certain of the possible embodiments of the invention are further described by way of examples with reference to the related schematic drawings. In the drawings:

[19] Fig. 1 is a cross-sectional view of a bypass turbojet engine;

[20] Fig. 2 is a cross-sectional view of the bypass turbojet engine taken along line A-A of Fig. 1;

[21] Fig. 3 is a cross-sectional perspective view of the bypass turbojet engine;

[22] Fig. 4 is cross-sectional view of a horizontally situated axial flow turbine;

[23] Fig. 5 is a cross-sectional view of vertically situated Kaplan turbine with an impeller and without a guide wheel;

[24] Fig. 6 is a partial cross-sectional view of the extra blade wheel taken along line B-B of Fig. 5.

Mode for the Invention

Mode for Invention

[25] The following examples represent various embodiments of the fluid machine according to the invention, whereby the identical or nearly identical components as for their function and purpose may bear the same referring numerals.

[26] A bypass turbojet engine in a simple embodiment with one aerodynamically formed shaft 1 and one exhaust fluid driven turbine 15 is shown in a cross-sectional front view in Fig. 1 and in a perspective cross-sectional view in Fig. 3. The shaft 15 is rotatably mounted in an engine body 5 and its front part bears an impeller - in this example a fan 12 whose blades extend by their outer ends close to a clothing wall 4 surrounding the engine body 5. Downstream the fan, the shaft further carries blades of an axial multistage compressor 14. Combustion chambers 52 are disposed along the perimeter of the medium part of the shaft 1 while the rear engine part includes a blades of a turbine 15 also carried by the shaft 1 and followed by the outlet cone defining an annular space of an exit nozzle 51. An annular air bypass channel 41 is formed between the inner wall of the clothing 4 and the engine body 5. As shown in Fig. 2 and 3, blades of an extra blade wheel 2 extend into the bypass channel 41 at a distance of approximately 0.25 multiples of the diameter of the fan 12. A hub 21 of the extra blade wheel 2 is mounted on a bearing 32 fitted to a hollow journal 31, which is secured to the engine body 5. The hub 21 includes a rotor assembly of an electric generator and the hollow shaft 31 includes a corresponding stator assembly of this electric generator.

[27] A portion of air compressed by the fan 12 is directed into the axial compressor stage while the other portion of air flows through the bypass channel 41 so that in the exit nozzle both streams are mixed to generate the engine thrust. The blades of the extra blade wheel 2 are situated parallel to the engine longitudinal axis and are activated by a radial or rotational component of the stream vortex generated downstream the fan 12.

The mechanical energy of the rotating extra blade wheel 2 is converted by the generator to electrical energy which may be used for feeding various electrical appliances of the engine powered machine, for example an aircraft.

[28] The above embodiment of the invention is described by way of example only and do not exclude another positioning of the blade wheel 2, for example in the area of the engine exit nozzle 51. The blades of the extra blade wheel may have an aerodynamic shape and further associated with a mechanism for adjusting their position with respect to the direction of the fluid stream.

[29] Another example of the application of an extra blade wheel to a fluid engine in the form of water turbine is illustrated in a simplified view in absence of a guide wheel in Fig. 4. A horizontally situated impeller - water S- turbine runner wheel 61 coupled with an electric generator 62 is situated within the turbine clothing 8 in the entrance tube with the water flow direction denoted by arrow 82. Downstream the runner wheel 61, an extra blade wheel 7 is located at a distance equal to a diameter of the runner wheel 61. The extra blade wheel 7 is mounted on a common shaft 75 together with an auxiliary generator 76. The distance between the runner wheel 61 and the extra blade wheel 7 is dependent inter alia on the density and the velocity of the liquid, cross-sections ratio etc. The extra blade wheel 7 for driving of the auxiliary generator 76 is actuated by a rotational power component of the vortex generated by the runner wheel 61.

[30] A more detailed view of another, in this case vertical arrangement of a water turbine of a Kaplan turbine type is shown in Fig. 5 and Fig. 6. The turbine is also illustrated in a simplified form without a guide wheel. The impeller - runner wheel 61 of the turbine is born by a shaft 6 arranged in a vertical position inside a turbine clothing 8. Under the turbine, am extra blade wheel 7 is situated. The blades of the extra blade wheel are embedded by their outer ends in a peripheral ring 72 and by their inner ends in a central ring 78. The peripheral ring 72 is carried in a tapered roller bearing 73. A winding assembly of a rotor 71 of a generator is arranged along the perimeter of the peripheral ring 72. The winding of a corresponding stator 81 of the generator is built in opposite to it, in the turbine clothing 8. The generator is watertight sealed towards the internal room of the clothing 8 by a package 74. The blades are mounted on pivots 77 fixed in the peripheral ring 72 and are associated with a non-illustrated adjusting mechanism. As in the preceding example, the extra blade wheel 7 powering the rotor 71 of the generator is actuated by rotational force component of the vortex generated by the runner wheel 61. The blade adjusting mechanism enables optimal regulation of the speed of the extra blade wheel 7 and simultaneously adjusting the characteristics of water flow in the draft tube downstream the extra blade wheel 7.

[31] The foregoing examples of the embodiment of the invention do not limit the

described process of conversion of the extra blade wheel kinetic energy to electric energy. The electric generator may be substituted by another device for conversion of the blade wheel kinetic energy. For example, instead of an auxiliary generator 76 in Fig. 4 a hydraulic pump may be utilized as a source of pressure energy. The cross-sectional area of the clothing in the area of blade wheel may be enlarged to eliminate the change in the flow rate in the blade wheel due to a passive elements of the blade wheel supporting structure, etc.

Industrial Applicability

[32] The extra blade wheel structure according to the invention may be applied to all fluid machines with a impeller actuated by kinetic or pressure fluid energy, such as water or gas turbines or fluid machines generating the kinetic energy by means of a power unit such blowers, suction or pressure fans etc.

Claims

[Claim 1] 1. A fluid machine having an impeller (12; 61) with a plurality of blades and including a fluid inlet room and a fluid outlet room characterized in that an extra blade wheel (2; 7) rotatably mounted independent of the rotation of the impeller (12; 61) is located on the downstream side of the impeller (12; 61) and this extra blade wheel (2; 7) is associated with a device for conversion of the extra blade wheel kinetic energy into electric or pressure energy.

2. The fluid machine of claim 1, wherein the extra blade wheel (2; 7) is located at the distance equal to 0.2 up to 2 multiple of the outside diameter of the impeller (12; 61).

3. The fluid machine of claims 1 or 2, wherein t he position of blades of the extra blade wheel with respect to the fluid stream is controlled by an adjusting mechanism.

4. The fluid machine of any of claims 1 to 3, wherein the device for conversion of the kinetic energy is an electric generator or a hydraulic pump.

5. The fluid machine of any of claims 1 to 4, wherein t he impeller is a fan (12) of an air bypass turbojet engine and the blades of the extra blade wheel (2) are located in the air bypass channel (41).

6. The fluid machine of claim 5, wherein the extra blade wheel (2) comprises a hub (21) carrying a rotor of an electric generator and rotatably mounted on a hollow journal (31) fixed to the engine body (5) and including a stator of the electric generator.

7. The fluid machine of any of claims 1 to 5, wherein t he impeller is a runner wheel (61) of a water turbine.

8. The fluid machine of claim 7, wherein t he outer ends of the blades of the extra blade wheel (7) are attached to a watertight sealed peripheral ring (72) for receiving a rotor (71) of an electric generator and carried in bearings (73) incorporated in a turbine clothing (8) together with a stator (81) of the electric generator.

Fig. 1

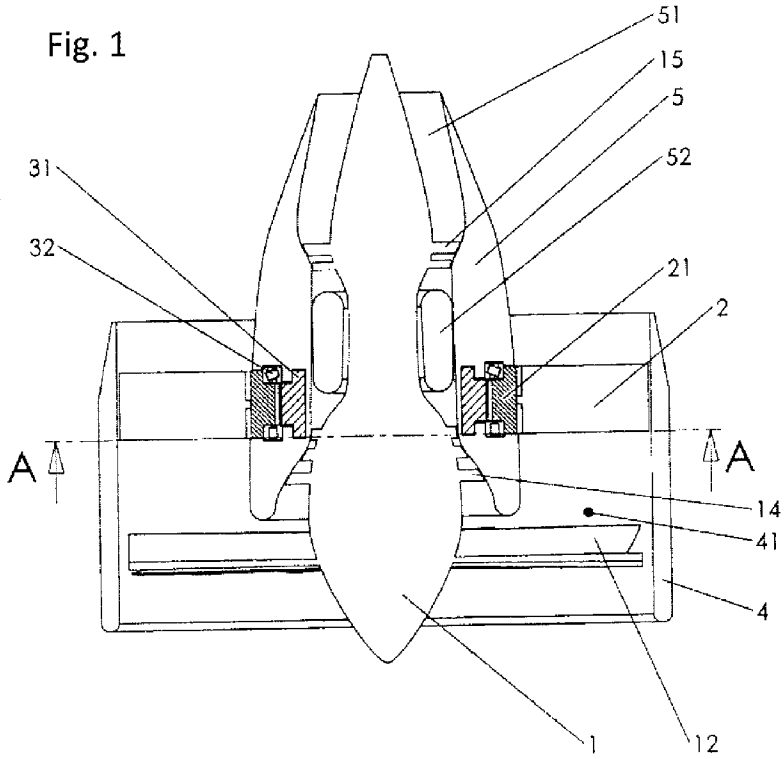


Fig. 2

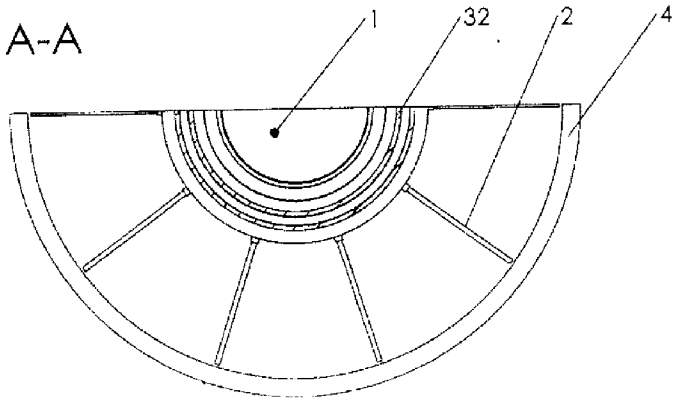


Fig. 3

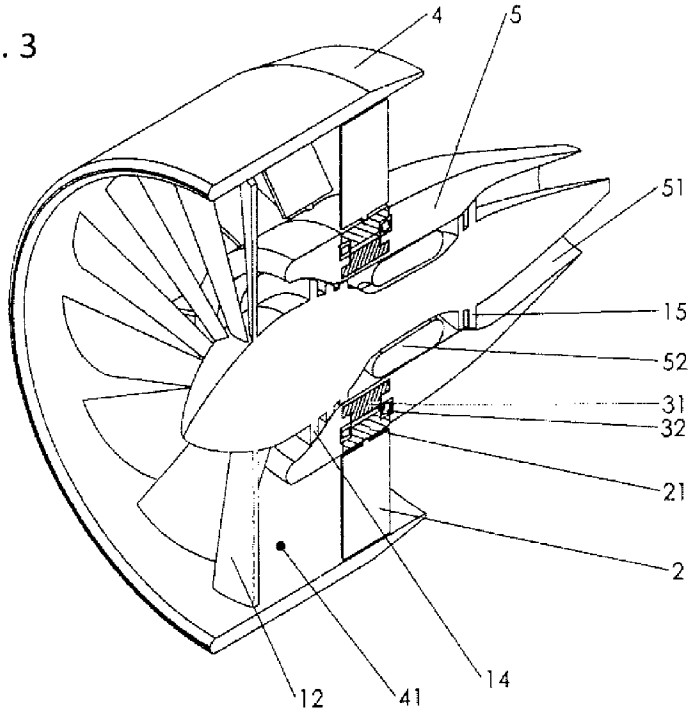


Fig. 4

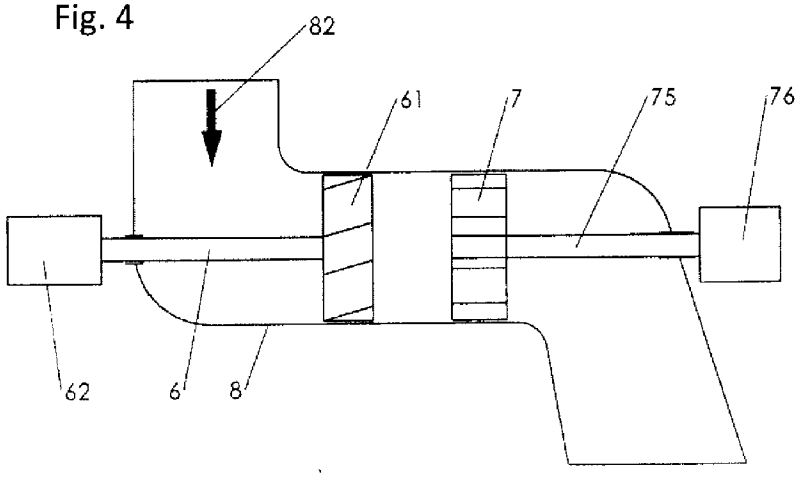


Fig. 5

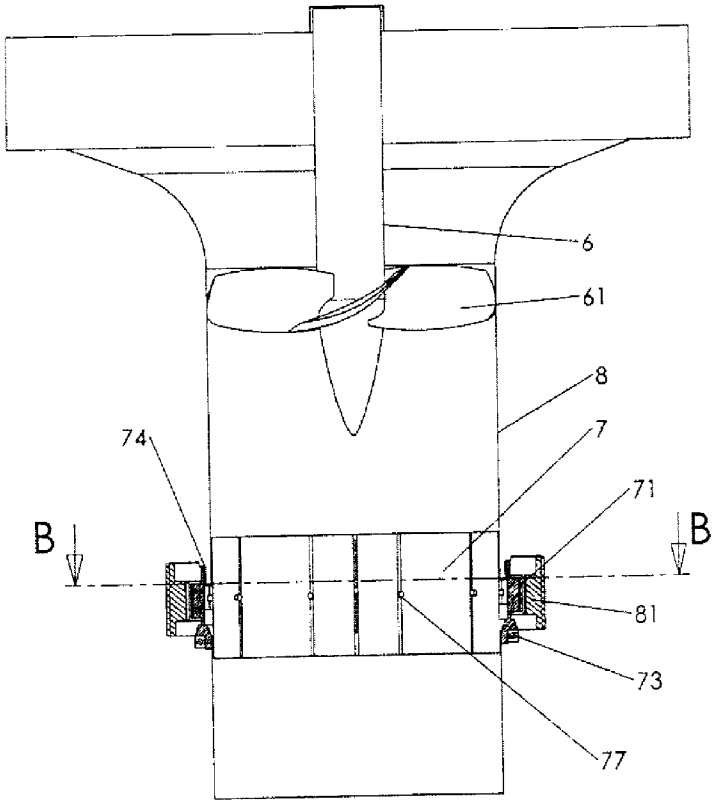
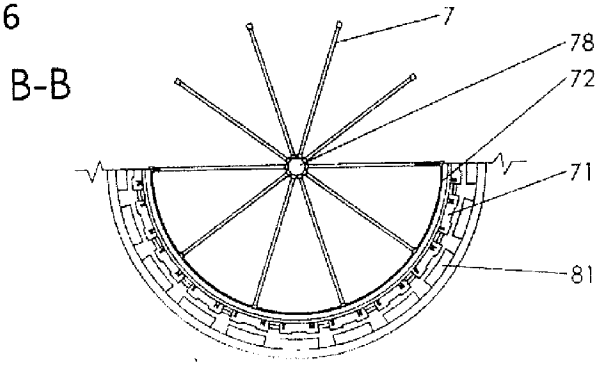


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/050963

A. CLASSIFICATION OF SUBJECT MATTER
INV. F02C3/10 F02K3/06 F03B3/02 F03B3/06
ADD.

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)
F02C F02K F03B F01D

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/169462 A1 (SHARP JOHN [DE] ET AL) 26 July 2007 (2007-07-26) the whole document -----	1-6
X	CH 316 900 A (ESCHER WYSS AG [CH]) 31 October 1956 (1956-10-31) page 2, line 9 - line 48 page 2, line 84 - page 3, line 21 figures 1-4 -----	1-4,7,8
X	JP 2008 014202 A (KAWASAKI HEAVY IND LTD) 24 January 2008 (2008-01-24) abstract; figures ----- -/--	1,2,4,7, 8

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 June 2012	25/06/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	O'Shea, Gearóid

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/050963

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/153124 A2 (SIEMENS AG [DE]; SCHROEDER DIERK [DE]) 23 December 2009 (2009-12-23) page 3, line 8 - line 21 page 11, line 6 - page 13, line 27 abstract; figures 1,2	1,4,7,8
X	DE 43 20 180 A1 (ARTINANO ANTONIO [CR]) 23 December 1993 (1993-12-23) page 11, line 34 - line 40 figure 3	1,4,7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2012/050963

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007169462 A1	26-07-2007	DE 102004004945 A1	18-08-2005
		EP 1711690 A1	18-10-2006
		US 2007169462 A1	26-07-2007
		WO 2005073519 A1	11-08-2005
CH 316900 A	31-10-1956	NONE	
JP 2008014202 A	24-01-2008	JP 4795144 B2	19-10-2011
		JP 2008014202 A	24-01-2008
WO 2009153124 A2	23-12-2009	EP 2279113 A2	02-02-2011
		WO 2009153124 A2	23-12-2009
DE 4320180 A1	23-12-1993	NONE	