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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 June 2015 (25.06.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/092510 A3

(51) International Patent Classification:
B60W 10/06 (2006.01) *B60W 20/00* (2006.01)

(21) International Application Number:
PCT/IB2014/002725

(22) International Filing Date:
10 December 2014 (10.12.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2013-262406 19 December 2013 (19.12.2013) JP

(71) Applicant: **TOYOTA JIDOSHA KABUSHIKI KAISHA** [JP/PA]; 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP).

(72) Inventors: **TERAYA, Ryuta**; c/o TOYOTA JIDOSHA KABUSHIKI KAISHA, of 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP). **KATO, Toshikazu**; c/o TOYOTA JIDOSHA KABUSHIKI KAISHA, of 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP). **ASAMI, Yoshikazu**; c/o TOYOTA JIDOSHA KABUSHIKI KAISHA, of 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP).

(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, BN, 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, IR, IS, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, KM, ML, MR, NE, SN, TD, TG).

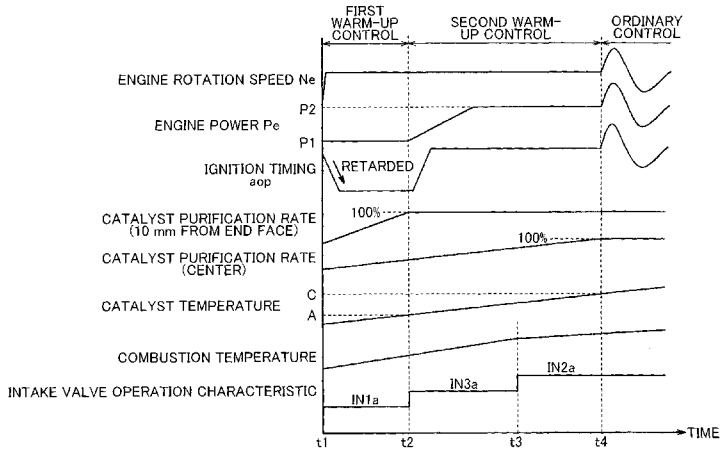
Published:

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

(88) Date of publication of the international search report:
12 November 2015

(54) Title: HYBRID VEHICLE, CONTROLLER FOR HYBRID VEHICLE, AND CONTROL METHOD FOR HYBRID VEHICLE WITH TWO STAGES CATALYST WARM-UP IN RELATIONSHIP WITH VARIABLE INTAKE VALVE TIMING

FIG. 10



(57) Abstract: A hybrid vehicle includes an electric motor, an internal combustion engine, an exhaust emission control device and a controller. The controller is configured to execute catalyst warm-up control for warming up a catalyst of the exhaust emission control device. The catalyst warm-up control includes first control and second control. The first control is control for operating the internal combustion engine at a first operating point. The second control is control for, after the first control is executed, operating the internal combustion engine at a second operating point irrespective of a driving force that is required to propel the hybrid vehicle. An output of the internal combustion engine at the second operating point is larger than an output of the internal combustion engine at the first operating point. The controller is configured to operate the internal combustion engine while an ignition timing of the internal combustion engine at the time when the first control is executed is set to a retarded side with respect to an ignition timing of the internal combustion engine at the time when the second control is executed. The controller is configured to, when the first control is executed, control the variable valve actuating device such that the operation characteristic becomes the first characteristic. The controller is

[Continued on next page]

WO 2015/092510 A3

configured to, when the second control is executed, control the variable valve actuating device such that the operation characteristic is changed to the second characteristic. The controller is configured to, after the second control is executed, operate the internal combustion engine on the basis of the driving force that is required to propel the hybrid vehicle and control the variable valve actuating device on the basis of a rotation speed and torque of the internal combustion engine.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/002725

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60W10/06 B60W20/00
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)
B60K B60W

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2 145 808 A1 (TOYOTA MOTOR CO LTD [JP]) 20 January 2010 (2010-01-20) paragraphs [0015], [0033] - [0036]; figures 5,6	1-11
A	EP 1 482 155 A2 (TOYOTA MOTOR CO LTD [JP]) 1 December 2004 (2004-12-01) paragraphs [0052] - [0068], [0089]; figures 1,2	1-11
A	EP 1 837 223 A1 (NISSAN MOTOR [JP]) 26 September 2007 (2007-09-26) paragraphs [0026] - [0030]	1-11
A	WO 2013/076570 A1 (TOYOTA MOTOR CO LTD [JP]; DENSO CORP [JP]; ANDO IKUO [JP]; SASAKI TOSH) 30 May 2013 (2013-05-30) paragraphs [0030], [0057] - [0060]; figures 3,4,6	1-11

☐ Further documents are listed in the continuation of Box C.

☒ 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
29 June 2015	10/07/2015

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	Rinchard, Laurent

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/002725

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2145808 A1	20-01-2010	CN 101678827 A	24-03-2010
		EP 2145808 A1	20-01-2010
		JP 4183013 B1	19-11-2008
		JP 2008284909 A	27-11-2008
		US 2010152938 A1	17-06-2010
		WO 2008143045 A1	27-11-2008
EP 1482155 A2	01-12-2004	EP 1482155 A2	01-12-2004
		JP 2005009474 A	13-01-2005
		US 2004237510 A1	02-12-2004
EP 1837223 A1	26-09-2007	CN 101037963 A	19-09-2007
		EP 1837223 A1	26-09-2007
		JP 4424321 B2	03-03-2010
		JP 2007245852 A	27-09-2007
		US 2007219702 A1	20-09-2007
WO 2013076570 A1	30-05-2013	CN 103958246 A	30-07-2014
		EP 2782773 A1	01-10-2014
		JP 2013112033 A	10-06-2013
		US 2014297088 A1	02-10-2014
		WO 2013076570 A1	30-05-2013