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TERAYA, Ryuta; c/o TOYOTA JIDOSHA KABUSHIKI KAISHA, of 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP).

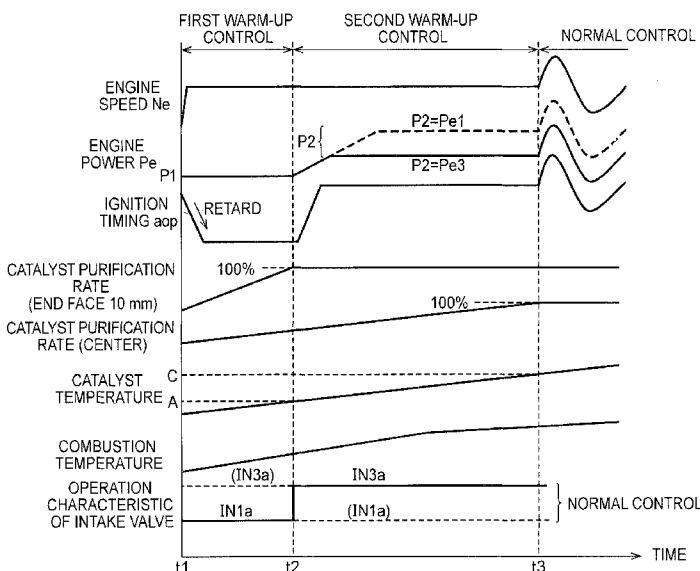
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[Continued on next page]

(54) Title: HYBRID VEHICLE, CONTROLLER FOR HYBRID VEHICLE, AND CONTROL METHOD FOR HYBRID VEHICLE

FIG. 11



(57) Abstract: A hybrid vehicle includes an electric motor, an internal combustion engine, an exhaust emission control device, and a controller. The electric motor is configured to generate a driving force for the vehicle. The internal combustion engine includes a variable valve actuating device. The variable valve actuating device is configured to control at least one of a valve lift and a valve operating angle as an operation characteristic of an intake valve. The exhaust emission control device is configured to control an exhaust emission of the internal combustion engine by using a catalyst. The controller is configured to execute catalyst warm-up control. The catalyst warm-up control is control for performing warm-up on the catalyst of the exhaust emission control device. The catalyst warm-up control includes first warm-up control and second warm-up control. The first warm-up control is control for operating the internal combustion engine at a first operating point. The second warm-up control is control for operating the internal combustion engine at a second operating point, regardless of the driving force required for traveling, after the execution of the first warm-up control. An output of the internal combustion

engine at the second operating point exceeds an output of the internal combustion engine at the first operating point. The controller is configured to operate the internal combustion engine with ignition timing of the internal combustion engine during the execution of the first warm-up control further on a retard side than ignition timing of the internal combustion engine during the execution of the second warm-up control. The controller is configured to set the output of the internal combustion engine and the operation characteristic of the intake valve in accordance with a predetermined characteristic relationship during the execution of the second warm-up control. The predetermined characteristic relationship is a relationship in which the output of the internal combustion engine and the operation characteristic of the intake valve correspond to each other.

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A. CLASSIFICATION OF SUBJECT MATTER
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B. FIELDS SEARCHED
 Minimum documentation searched (classification system followed by classification symbols)
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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)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|---|-----------------------|
| X | US 2014/007561 A1 (HABU IKUE [JP] ET AL) 9 January 2014 (2014-01-09) | 1,5,8-11 |
| Y | figures 1-4,13 abstract paragraphs [0036], [0039], [0044], [0059], [0062] - [0064], [0072] - [0075], [0086] | 3,4,6,7 |
| Y | ----- JP 2009 174462 A (TOYOTA MOTOR CORP) 6 August 2009 (2009-08-06) figure 1 paragraphs [0036], [0047] - [0048] | 3,4 |
| Y | ----- EP 1 428 991 A1 (DELPHI TECH INC [US]) 16 June 2004 (2004-06-16) figures 1-2 claim 1 ----- | 6,7 |
| | -/-- | |

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|---|---|
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International application No
PCT/IB2015/000391

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT | | |
|--|---|-----------------------|
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| A | EP 1 350 936 A2 (TOYOTA MOTOR CO LTD [JP]) 8 October 2003 (2003-10-08) the whole document | 1,10,11 |
| | ----- | |
| E | WO 2015/092509 A1 (TOYOTA MOTOR CO LTD [JP]) 25 June 2015 (2015-06-25) figures 2,11-13 | 1-11 |
| | ----- | |
| E | WO 2015/128721 A2 (TOYOTA MOTOR CO LTD [JP]) 3 September 2015 (2015-09-03) figures 2,10 | 1-11 |
| | ----- | |

INTERNATIONAL SEARCH REPORT

Information on patent family members

| |
|---|
| International application No PCT/IB2015/000391 |
|---|

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|--|------------------|-------------------------|------------------|
| US 2014007561 A1 | 09-01-2014 | JP 5632882 B2 | 26-11-2014 |
| | | JP 2014015114 A | 30-01-2014 |
| | | US 2014007561 A1 | 09-01-2014 |
| ----- | | | |
| JP 2009174462 A | 06-08-2009 | JP 5003511 B2 | 15-08-2012 |
| | | JP 2009174462 A | 06-08-2009 |
| ----- | | | |
| EP 1428991 A1 | 16-06-2004 | EP 1428991 A1 | 16-06-2004 |
| | | US 2004107927 A1 | 10-06-2004 |
| | | US 2005056244 A1 | 17-03-2005 |
| ----- | | | |
| EP 1350936 A2 | 08-10-2003 | DE 60301291 D1 | 22-09-2005 |
| | | DE 60301291 T2 | 29-06-2006 |
| | | EP 1350936 A2 | 08-10-2003 |
| | | JP 2003286869 A | 10-10-2003 |
| | | US 2003182931 A1 | 02-10-2003 |
| ----- | | | |
| WO 2015092509 A1 | 25-06-2015 | JP 2015116959 A | 25-06-2015 |
| | | WO 2015092509 A1 | 25-06-2015 |
| ----- | | | |
| WO 2015128721 A2 | 03-09-2015 | JP 2015157590 A | 03-09-2015 |
| | | WO 2015128721 A2 | 03-09-2015 |
| ----- | | | |