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## (71) Applicant: UNITED TECHNOLOGIES CORPORATION [US/US]; One Financial Plaza, Hartford, Connecticut 06101 (US).

## (72) Inventors: MEISNER, Richard P.; 185 Butler Drive, Glastonbury, Connecticut 06033 (US). WINEBRENNER, Brian V.; 27 Nedwied Road, Tolland, Connecticut 06084 (US). FEULNER, Matthew R.; 4 Bainbridge Road, West Hartford, Connecticut 06447 (US). KARPMAN, Boris; 91 Jerry Daniels Road, Marlborough, Connecticut 06447 (US). MA, David L.; 35 Arlington Drive, Avon, Connecticut 06001 (US).

## (74) Agents: COLLINS, Michael A. et al.; Kinney &amp; Lange, P.A., 312 South Third Street, Minneapolis, Minnesota 55415-1028 (US).

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## (88) Date of publication of the international search report:

12 September 2014

## (54) Title: MODEL BASED FUEL-AIR RATIO CONTROL

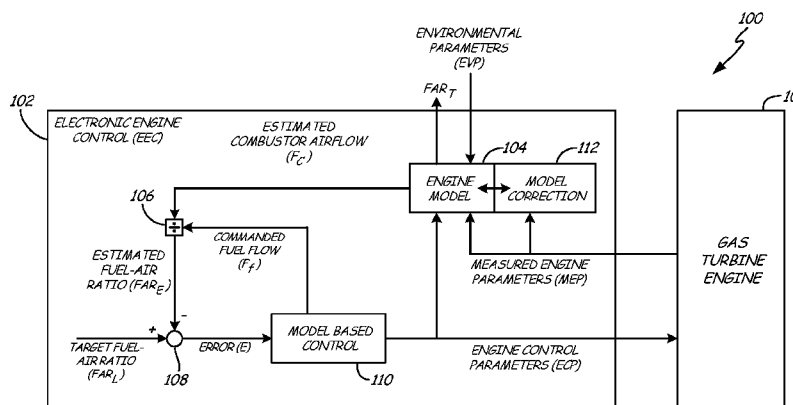


Fig. 2

(57) Abstract: A gas turbine engine comprises a compressor, a combustor, a turbine, and an electronic engine control system. The compressor, combustor, and turbine are arranged in flow series. The electronic engine control system is configured to estimate combustor fuel-air ratio based on a realtime model-based estimate of combustor airflow, and commands engine actuators to correct for a difference between the estimated combustor fuel-air ratio and a limit fuel-air ratio selected to avoid lean blowout.

## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2013/061636****A. CLASSIFICATION OF SUBJECT MATTER****F02C 9/26(2006.01)i, F23R 3/30(2006.01)i, F23R 3/26(2006.01)i**

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 9/26; F02C 3/22; G01M 15/14; F02C 9/28; F23R 3/30; F23R 3/26

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

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) &amp; Keywords: engine, compressor, combustor, turbine, fuel-air ratio, engine model and actuator

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                             | Relevant to claim No.  |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Y         | US 5743079 A (WALSH et al.) 28 April 1998<br>See column 2, line 6 - column 4, line 3, column 7, line 11 - column 9, line 63, column 10, line 24 - column 11, line 23, claim 1 and figures 1-3. | 1-19                   |
| Y         | US 4566266 A (KIDD et al.) 28 January 1986<br>See column 5, lines 10-18, 34-53 and figure 1.                                                                                                   | 1-19                   |
| Y         | US 7849732 B2 (PASHLEY, NICHOLAS C) 14 December 2010<br>See abstract, column 1, lines 22-29, 41-44, column 4, lines 8-16, 19-22 and figure 2.                                                  | 4, 5, 9, 16            |
| A         |                                                                                                                                                                                                | 1-3, 6-8, 10-15, 17-19 |
| Y         | US 4423594 A (ELLIS, STANLEY H.) 03 January 1984<br>See column 15, lines 32-38, column 16, lines 20-23 and figure 12.                                                                          | 14                     |
| A         |                                                                                                                                                                                                | 1-13, 15-19            |
| A         | US 3747340 A (FENTON et al.) 24 July 1973<br>See column 1, lines 40-49, column 3, lines 58-66 and figure 2.                                                                                    | 1-19                   |



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&amp;" document member of the same patent family

Date of the actual completion of the international search

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International Application Division  
Korean Intellectual Property Office  
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701,  
Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

JEONG, A Ram

Telephone No. +82-42-481-3388



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2013/061636**

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)                                          | Publication<br>date                                  |
|-------------------------------------------|---------------------|---------------------------------------------------------------------|------------------------------------------------------|
| US 05743079 A                             | 28/04/1998          | EP 0765998 A2<br>EP 0765998 A3<br>EP 0765998 B1                     | 02/04/1997<br>07/04/1999<br>25/07/2001               |
| US 04566266 A                             | 28/01/1986          | EP 0153056 A2<br>EP 0153056 A3<br>EP 0153056 B1<br>JP 60-187719 A   | 28/08/1985<br>18/12/1985<br>12/04/1989<br>25/09/1985 |
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| US 04423594 A                             | 03/01/1984          | None                                                                |                                                      |
| US 3747340 A                              | 24/07/1973          | None                                                                |                                                      |