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(54) **PREHEATING OF FLUID IN A SUPERCRITICAL BRAYTON CYCLE POWER GENERATION SYSTEM AT COLD STARTUP**

(75) Inventors: **Steven A. Wright**, Albuquerque, NM (US); **Robert L. Fuller**, Conifer, CO (US)

(73) Assignee: **Sandia Corporation**, Albuquerque, NM (US)

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CPC ***F04D 25/04*** (2013.01); ***F02B 39/10*** (2013.01); ***F02B 39/14*** (2013.01); ***F04D 29/063*** (2013.01)

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CPC F02B 39/10; F02B 39/14; F04D 25/04; F04D 29/063
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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,882,687	A *	4/1959	Stivender	60/661
3,788,066	A *	1/1974	Nebgen	60/775
6,564,556	B2 *	5/2003	Ginter	60/775
6,910,335	B2	6/2005	Vitero et al.	
7,154,931	B2	12/2006	Emanuel	
7,466,045	B2	12/2008	Andres	
7,695,260	B2	4/2010	Holtzapple et al.	
7,726,959	B2	6/2010	Holtzapple et al.	
2007/0245735	A1 *	10/2007	Ashikian	60/659
2010/0154381	A1	6/2010	Rapp et al.	
2010/0156112	A1	6/2010	Held et al.	

FOREIGN PATENT DOCUMENTS

WO WO 2010129274 A2 * 11/2010

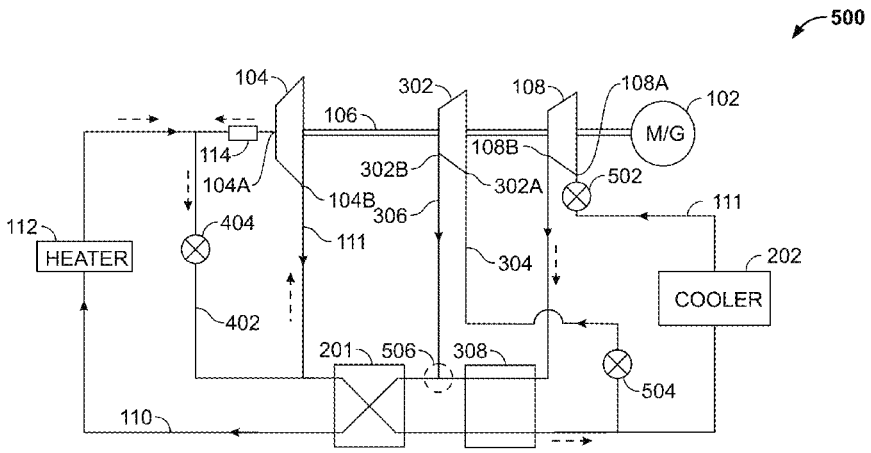
OTHER PUBLICATIONS

Angelino G., "Perspectives for the Liquid Phase Compression Gas Turbine", Journal of Engineering for Power, Trans. ASME, vol. 89, No. 2, pp. 229-237, Apr. 1967.
Angelina G., "Carbon Dioxide Condensation Cycles for Power Production", ASME Paper No. 68-GT-23, pp. 1-9, 1968.
Angelina G., "Real Gas. Effects in Carbon Dioxide Cycles", ASME Paper No. 69-GT-102, pp. 1-12, 1989.
Dostal V. Driscoll, M.J. and Hejzlar, P. "A Supercritical Carbon Dioxide Cycle for Next Generation Nuclear Reactors," MIT-ANP-TR-100, Mar. 2004.
Hoffman, et al., "150 Kwe Supercritical Closed Cycle System ", Transactions of the ASME, pp. 70-80, Jan. 1971.

* cited by examiner

Primary Examiner — Jesse Bogue
Assistant Examiner — Paul Thiede
(74) *Attorney, Agent, or Firm* — Daniel J. Jenkins

(57) **ABSTRACT**

Various technologies pertaining to causing fluid in a supercritical Brayton cycle power generation system to flow in a desired direction at cold startup of the system are described herein. A sensor is positioned at an inlet of a turbine, wherein the sensor is configured to output sensed temperatures of fluid at the inlet of the turbine. If the sensed temperature surpasses a predefined threshold, at least one operating parameter of the power generation system is altered.

11 Claims, 10 Drawing Sheets