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Law

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(54) **GEARTRAIN COUPLING FOR A TURBOFAN ENGINE**

(75) Inventor: **Chi Law**, South Glastonbury, CT (US)

(73) Assignee: **United Technologies Corporation**, Hartford, CT (US)

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(52) **U.S. Cl.** **60/226.1**; 60/262; 384/913

(58) **Field of Classification Search** 60/226.1, 60/226.3, 262, 263, 793; 384/913
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,787,603	A	4/1957	Palsullch et al.	
3,922,852	A *	12/1975	Drabek	60/226.1
4,251,987	A *	2/1981	Adamson	60/805
4,751,816	A *	6/1988	Perry	60/226.1
4,799,354	A *	1/1989	Midgley	60/788
4,827,712	A *	5/1989	Coplin	60/226.1
4,887,424	A	12/1989	Geidel et al.	
5,010,729	A *	4/1991	Adamson et al.	60/226.1
5,107,676	A *	4/1992	Hadaway et al.	60/226.1
5,349,814	A *	9/1994	Ciokajlo et al.	60/226.1
6,158,893	A *	12/2000	Heshmat	384/106
6,284,366	B1 *	9/2001	Konig et al.	428/336
6,517,249	B1 *	2/2003	Doll	384/492
6,622,473	B1	9/2003	Becquerelle et al.	
6,655,842	B1	12/2003	Kanayama et al.	
6,732,606	B1 *	5/2004	Zhu et al.	74/460
6,815,400	B1	11/2004	Jee et al.	

FOREIGN PATENT DOCUMENTS

GB 705067 3/1954

OTHER PUBLICATIONS

Chhowalla et al. "Thin films of fullerence-like MOS2 nanoparticles with ultra-low friction and wear", Engineering Department, University of Cambridge, pp. 164-167, Jun. 2000.*

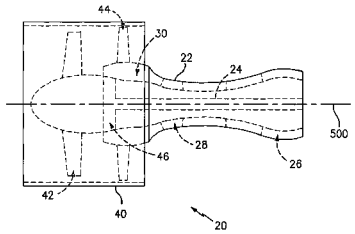
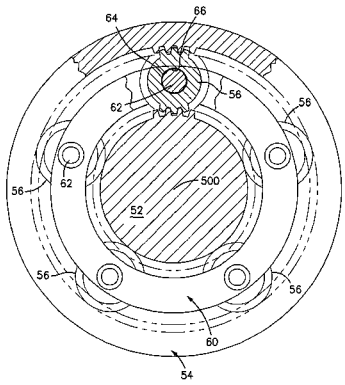
Zabinski et al. "The effects of dopants on the chemistry and tribology of sputter-deposited MOS2 films", Tribology Transactions, vol. 38, pp. 894-904, Oct. 1995.*

S.W. Kandebo, Pratt & Whitney Launches Geared Turbofan Engine, Aviation Week & Space Technology, Feb. 23, 1998, pp. 32-34.

* cited by examiner

Primary Examiner—William H. Rodriguez
(74) *Attorney, Agent, or Firm*—Bachman & LaPointe, P.C.

(57) **ABSTRACT**

Molybdenum disulfide (MoS_2) is used as a journal coating for a gearing system. A particular application is the planetary gear system of a geared turbofan engine. Particularly advantageous coatings are deposited via physical vapor deposition (PVD) techniques.

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