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Franks et al.

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(54) **INTERNAL COMBUSTION ENGINE INCLUDING AN INJECTOR COMBUSTION SEAL POSITIONED BETWEEN A FUEL INJECTOR AND AN ENGINE BODY**

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CPC **F02M 61/14** (2013.01); **F02M 2200/858** (2013.01)

(58) **Field of Classification Search**
CPC **F02M 53/06**; **F02M 53/04**; **F02M 2200/9038**; **F02M 2200/858**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,841,277	A *	10/1974	Schafer	123/470
3,868,939	A *	3/1975	Friese et al.	123/179.15
3,945,353	A *	3/1976	Dreisin	123/41.22
4,296,887	A *	10/1981	Hofmann	F02M 61/14
				123/271
4,609,150	A	9/1986	Pane, Jr. et al.	
4,620,516	A	11/1986	Reüm et al.	
5,345,913	A *	9/1994	Belshaw et al.	123/470
5,361,990	A *	11/1994	Pimentel	239/133
5,785,024	A *	7/1998	Takei	F02F 11/00
				123/470

(Continued)

FOREIGN PATENT DOCUMENTS

DE	35 29 769	A1	2/1987
DE	3529769	A1	2/1987

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion dated Nov. 13, 2014 in corresponding International Application No. PCT/US2014/047589.

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(57) **ABSTRACT**

This disclosure provides a fuel injector seal assembly comprising a seal component fabricated or formed of a first material and a thermally conductive or heat transfer component fabricated or formed of a second material that is different from the first material. The first material has a greater strength than the second material, and the second material has a greater thermal conductivity than the first material. Thus, the injector seal assembly is able to provide a primary benefit of a combustion seal while also providing an enhanced benefit of transferring heat from one portion of the fuel injector to another portion of the fuel injector.

19 Claims, 3 Drawing Sheets

