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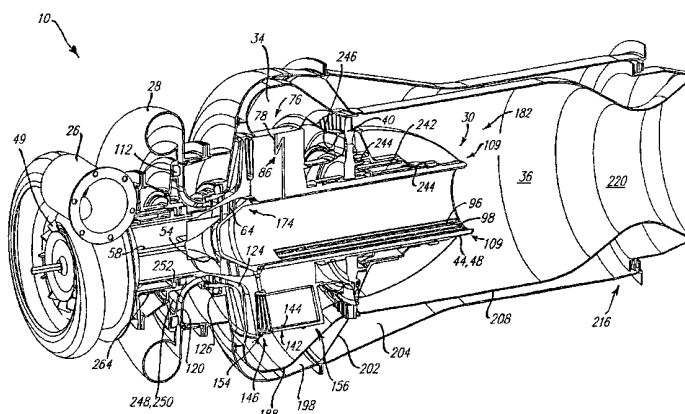
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[Continued on next page]

(54) Title: ROCKET ENGINE



(57) Abstract: A rocket engine (10) comprises first (76) and second (142) rotary injectors for injecting respective fuel (20) and oxidizer (18) propellant components into a first combustion chamber (34), and the effluent (38) therefrom drives a turbine (40) that rotates the rotary injectors (76, 142). The mixture within the first combustion chamber (34) is preferably fuel-rich so as to reduce the associated combustion temperature, and the fuel-rich effluent mixes in a second combustion chamber (36) with additional oxidizer injected by a third rotary injector (182) so as to generate a high temperature effluent (214) suitable for propulsion. The rotary injectors (76, 142, 182) are adapted with associated rotary pressure traps (86, 146, 174) so as to isolate the low pressure propellant supply (22', 24') from the relatively high pressures in the respective combustion chambers (34, 36). A portion of the fuel-rich effluent from the first combustion chamber (34) is directed through an annular passage (198, 204) surrounding the combustion chambers (34, 36) to provide effusion cooling of a surface (218) of the second combustion chamber (36).



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INTERNATIONAL SEARCH REPORT

 International application No.
PCT/US00/06393
A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : F02K 9/48, 9/52, 11/00; F23R 3/00

US CL : 60/258,204,267,259,240

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)

U.S. : 60/258,204,267,259,240

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 3,307,359 A (COWELL) 07 March 1967 (07.03.1967), the entire document.	1-15,20,45-51, 53-63, 89,90,92, 93,95-102, 104 ----- 16-19, 21-25, 52, 56, 98, 105-117
Y	US 3,408,817 A (WALTZ, et al.) 05 November 1968 (05.11.1968), Fig. 1.	16-19, 21-25, 52, 56, 98, 105-117

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
E earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*Z* document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means	
P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/06393

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2,637,973 A (LAWRENCE, JR.) 12 May 1953 (12.05.1953).	
A	US 3,440,821 A (WALTZ) 29 April 1969 (29.04.1969).	
A	US 2,518,881 A (GODDARD) 15 August 1950 (15.08.1950).	

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/06393

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
Please See Continuation Sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐
☐

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/06393

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING: This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-62, drawn to a rocket engine and method of operating the same, primarily limiting the means by which fuel and oxidizer are introduced and combusted.

Group II, claim(s) 63-88, drawn to a rotor sub-system of a rocket engine comprising features such as a rotary pressure trap for fuel and oxidizer.

Group III, claim(s) 89-117, drawn to a rocket engine having structure particular to the cooling thereof, and a method of cooling said rocket engine.

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The details claimed in the rotor sub-system (Group II) are not necessary nor present in the claims to either of groups I and III. Similarly, there is no corresponding technical feature shared between groups I and III.