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## EUROPEAN PATENT APPLICATION

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(54) **Ultra-high burn rate gun propellants.**

(57) A family of ultra-high burn rate gun propellant systems based upon a nitrocellulose binder matrix, and containing a variety of azide components to provide formulations having reduced isochoric flame temperatures and ultra-high mass consumption rates.

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BACKGROUND OF THE INVENTION1. Field of the Invention

5 This invention relates to propellants and is particularly directed to gun propellant formulations containing azido nitramines in conjunction with carboranes, to provide reduced isochoric flame temperatures and ultra-high mass consumption rates.

2. Description of Related Art

10 Various propellant formulations have evolved over the years in response to requirements for improved gun propellant compositions which impart high velocity and penetrability to associate projectiles. For modern applications, mass impetus levels approaching 450,000 ft-lb<sub>f</sub>/lb<sub>m</sub> or greater are desired. Such ultra-high force propellants have heretofore been dispossessed of the desirable combination of reduced isochoric  
15 flame temperatures and ultra-high mass consumption rates.

BRIEF SUMMARY AND OBJECTS OF THE INVENTION

20 The aforementioned disadvantages associated with known gun propellants are obviated by the present invention which encompasses a family of ultra-high burn rate gun propellants having acceptable impetus levels and lowered isochoric flame temperatures.

The advantages of the present invention are realized in propellant formulations utilizing a combination of select azide compounds and additives in a nitrocellulose binder matrix.

Accordingly, an object of the present invention is to provide improved propellants.

25 Another object of the present invention is to provide gun propellants having flame temperatures which are lower than those of current propellants, while yielding comparable or greater mass impetus.

These and other objects and features of the present invention will be apparent from the following detailed description.

30 FIG. 1 graphically compares the burn rates of propellant compositions according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

35 The propellants of the present invention are characterized by the utilization of highly energetic azido compounds and select plasticizers in a nitrocellulose matrix. Preferred energetic compounds which may be used in the gun propellant formulations include the cyclic nitramine 1,3,5-trinitro-1,3,5-triazacyclohexane (RDX) and 1,7-diazido-2,4,6-trinitrazaheptane (DATH) and mixtures thereof. The preferred plasticizers to be utilized are selected from 1,5-diazido-3-nitrazapentane (DANPE) or carbonylmethylpropionate (CMP) and mixtures thereof.

40 Propellant compositions having reduced isochoric flame temperatures and high mass impetus, prepared in accordance with the present invention, are set forth in the table below wherein M-9 corresponds to Military Specification No. MIL-P-20306.

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TABLE

5	WEIGHT PERCENT					Im	Tv
	NC(12.6%N)	DANPE	CMP	RDX	DATH	(J/G)	( ° K)
	24	0	6	70	0	1295	3601
	24	3	3	35	35	1338	3692
10	24	3	3	-	70	1355	3651
	18	6	6	-	70	1339	3515
	24	-	6	-	70	1325	3526
	24	6	-	-	70	1382	3790
15	M-9 (REFERENCE)					1175	3869

FIG. 1 is a graphic comparison of the burn rates in centimeters per second at 65 megapacals of various propellant formulations according to the instant invention. In FIG. 1, oxidizer 1 comprises 1,3,5-trinitro-1,3,5-triazacyclohexane (RDX), oxidizer 2 comprises a blend of fifty percent each RDX and 1,7-diazido-2,4,6-trinitraheptane (DATH) and oxidizer 3 comprises DATH. As shown, for example, with respect to the formulations above oxidizer 1, wherein DOP comprises dioctylphthalate and DANPE is 1,5-diazido-3-nitrazapentane, the first formulation comprises 6 wt. percent DOP, 24 wt. percent nitrocellulose (NC) and 70 wt. percent oxidizer which in this formulation is oxidizer 1 or RDX. In each formulation reference is made to the legend in the upper left hand corner of FIG. 1. As shown by FIG. 1, the novel compositions making up the propellant formulations of the present invention are a clear advancement over comparable formulations known in the art.

Obviously, numerous varifications and modifications may be made without departing from the present invention. Accordingly, it should be clearly understood that the forms of the present invention described above are not intended to limit the scope of the present invention.

### Claims

1. A composition of matter comprising a nitrocellulose binder matrix and a compound selected from the group consisting of 1,5-diazido-3-nitrazapentane; carbonylmethylpropionate; 1,3,5-trinitro-1,3,5-triazacyclohexane; 1,7-diazido-2,4,6-trinitraheptane, and mixtures thereof.
2. A composition of matter comprising:
  - (a) about 24 wt% nitrocellulose binder;
  - (b) about 6 wt% carbonylmethylpropionate; and
  - (c) about 70 wt% 1,3,5-trinitro-1,3,5-triazacyclohexane.
3. A composition of matter comprising:
  - (a) about 24 wt% nitrocellulose binder;
  - (b) about 3 wt% 1,5-diazido-3-nitrazapentane;
  - (c) about 3 wt% carbonylmethylpropionate;
  - (d) about 35 wt% 1,3,5-trinitro-1,3,5-triazacyclohexane; and
  - (e) about 35 wt% 1,7-diazido-2,4,6-trinitraheptane
4. A composition of matter comprising:
  - (a) about 24 wt% nitrocellulose binder;
  - (b) about 3 wt% 1,5-diazido-3-nitrazapentane;
  - (c) about 3 wt% carbonylmethylpropionate; and
  - (d) about 70 wt% 1,7-diazido-2,4,6-trinitraheptane.
5. A composition of matter comprising:
  - (a) about 18 wt% nitrocellulose binder;

- (b) about 6 wt% 1,5-diazido-3-nitrazapentane;
- (c) about 6 wt% carbonylmethylpropionate; and
- (d) about 70 wt% 1,7-diazido-2,4,6-trinitrazaheptane.

- 5    6. A composition of matter comprising:
- (a) about 24 wt% nitrocellulose binder;
  - (b) about 6 wt% carbonylmethylpropionate; and
  - (c) about 70 wt% 1,7-diazido-2,4,6-trinitrazaheptane.
- 10   7. A composition of matter comprising:
- (a) about 24 wt% nitrocellulose binder;
  - (b) about 6 wt% 1,5-diazido-3-nitrazapentane; and
  - (c) about 70 wt% 1,7-diazido-2,4,6-trinitrazaheptane.
- 15   8. A gun propellant according to Claim 1.
9. A gun propellant according to Claims 2,3,4,5,6,7, or 8.

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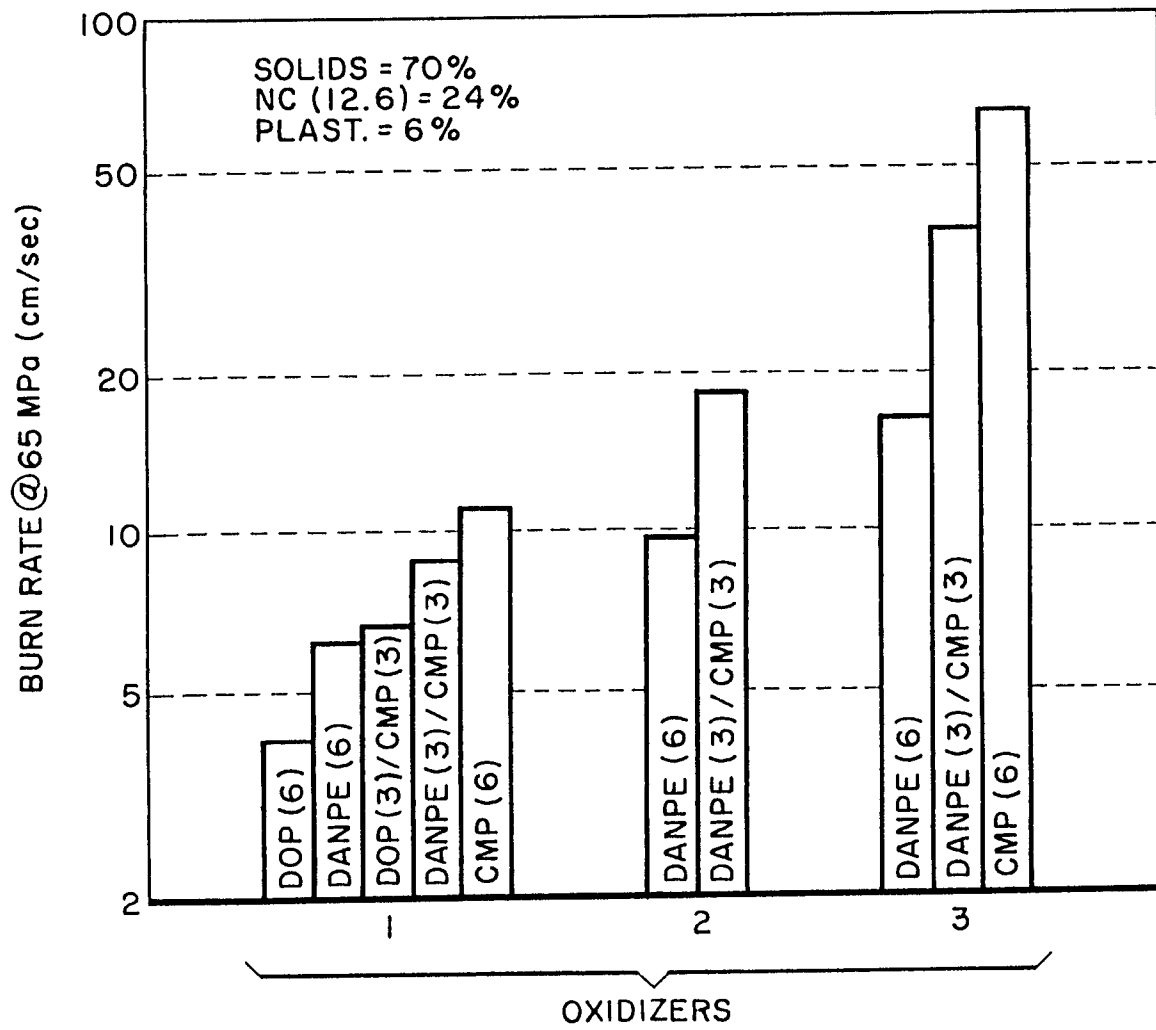
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*Fig. 1.*



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## EUROPEAN SEARCH REPORT

Application Number  
EP 93 11 6994

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	EP-A-0 445 357 (ROCKWELL INTERNATIONAL CORPORATION)	1,8	C06B45/10 C06B25/34
A	* page 1, line 42 - line 49; claims * ---	2-7,9	
X	GB-A-1 362 506 (ROCKWELL INTERNATIONAL CORPORATION)	1,8	
A	* claims * ---	2-7,9	
X	US-A-3 697 341 (R. ROSHER ET AL.)	1,8	
A	* claims * ---		
A	US-A-3 873 579 (R. ROSHER)	1-9	
A	* column 3, line 22 - line 43 * ---		
X	EP-A-0 120 668 (HERCULES INCORPORATED)	1,8	
A	* page 7 - page 8 * ---		
A	US-A-4 133 706 (R.D. SHOULTS)	1	TECHNICAL FIELDS SEARCHED (Int.Cl.5)  C06B
A	* column 2, line 24 - line 32 * * column 1, line 7 - line 9 * ---		
A	US-A-4 655 859 (D.C. SAYLES)	1	
A	* column 4, line 65 - line 67 * ---		
A	US-A-3 962 297 (W.E. HILL)	1	
A	* column 3, line 27 - line 44; claims * -----		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30 May 1994	Examiner Schut, R
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document  T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document			