

UNITED STATES PATENT OFFICE

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PROPELLENT POWDERS

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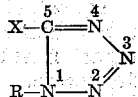
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The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to us of any royalty thereon.

This invention relates to propellant powders containing new and novel constituents chosen from among the class of materials known as the tetrazoles.

The tetrazoles are characterized by the type formula:



where X represents hydrogen or some negative group such as hydroxyl, amino, halogen or a low molecular weight alkyl radical and where R represents hydrogen or some low molecular weight alkyl radical. While these materials as a class are indicated to impart desirable characteristics to propellant powders containing them, we emphasize particularly 5-aminotetrazole as an outstanding example of this class of compounds in view of the fact that it imparts very unusual and highly favorable properties to powders which contain this agent.

In the design and manufacture of modern propellants, in particular for military purposes, every effort is made to achieve both smokelessness and flashlessness. An effort is made to approach these ideal requisites for the reason that gun positions are revealed by day if the gases resulting from the burning of the propellant powder contain appreciable quantities of solid particle in suspension, thereby producing smoke and are revealed by night if these same gases undergo vigorous combustion on issuing from the muzzle of the gun, producing what is commonly known as muzzle flash. Smokelessness has been achieved by several means:

a. By the use of nitrocellulose with a relatively high nitrogen content.

b. By the use of addends which either materially increase the oxygen balance of the propellant powder or give what is known as a hotter propellant thus insuring complete combustion.

c. By modifying the ignition system in order to effect more complete combustion as well as more rapid combustion.

In each of these cases, an effort is made to prevent the formation of carbon or other solid particles which would in turn produce smoke. This does not necessarily mean, however, that the composition of the propellant gases is such

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as to prevent subsequent burning on contact with the atmosphere. The fact that the temperature of these gases is above that of the explosion temperature for some of the combustible constituents, such as carbon monoxide and methane, invariably produces a large and prominent flash. Since these smokeless propellants have a high energy content, and develop high temperatures on reaction, excessive erosion of the gun barrel is thereby effected with the result that the life of the weapon is considerably reduced.

Flashlessness is generally attained by the addition of some inert constituent, either organic or inorganic such as dibutylphthalate, triacetin, potassium sulfate and other alkali sulfates, or potassium bitartrate. While the mechanism of their effect in reducing flash is not fully understood, flash is to a large degree eliminated, but in so doing considerable smoke is formed. Since these flash reducing agents are inert, provision must be made in the design of the powder, in its composition and in the quantity used for the reduction in potential occasioned thereby. Flash reducing agents such as heretofore used may either be employed in the form of separate charges in the cartridge case or may be incorporated directly into the powder.

Efforts have also been made to devise flashless powder compositions by the use of cool explosives such as nitroguanidine. Nitroguanidine has a very low explosion temperature and may replace nitrocellulose in propellant powders without affecting too greatly the ballistic potential of the powder. The nitroguanidine powders are, however, objectionable because of the fact that considerable quantities of toxic gases such as ammonia are found to be among the products of combustion. Even though flashlessness is achieved, such nitroguanidine powders are not sufficiently smokeless to be acceptable for various weapons.

It would appear from these recitations of prior art that the two objectives, i. e., smokelessness and flashlessness have not yet been attained in any one powder to the extent desired by any present procedure involving either design or change in composition of the powder. A flashless powder achieves this requirement at the expense of considerable smoke, whereas a smokeless powder is invariably characterized by the development of a considerable amount of muzzle flash.

We have found that the tetrazoles as a class do in fact achieve these two objectives to a degree heretofore unattained in propellant powders.

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The tetrazoles are compounds containing a high nitrogen content. Aminotetrazole in particular has a nitrogen content of 82.3%. When incorporated in a propellant powder with a nitrocellulose base it undergoes burning and decomposition with the formation of a large volume of nitrogen gas, thus diluting the combustible products remaining in the propellant gases. Unlike other addends, this decomposition or burning of aminotetrazole is not accompanied by any marked reduction in ballistic potential. By proper formulation of powders using the tetrazole, flash may be considerably reduced or entirely eliminated in various weapons. Aminotetrazole is unique among flash reducing agents in that it does not produce a large amount of smoke. Laboratory as well as surveillance tests of aminotetrazole powders indicate that these are more stable than many double base powders. Powders manufactured containing aminotetrazole have been found to be of acceptable mechanical strength and to give in closed bomb firings, relative force and relative quickness characteristics comparable to those of standard powders now in use. Actual gun firings furthermore demonstrate that the pressures developed as well as the projectile velocities achieved compare favorably with standard powders now in use. Our experimental work, therefore demonstrates that these aminotetrazole powders possess the necessary requisites of standard powders and in addition impart those very desirable characteristics of flashlessness and smokelessness to the propellant.

We have found that the mechanical addition of aminotetrazole either as a separate charge or dispersed through the powder achieves a considerable reduction in flash. We prefer, however, to incorporate aminotetrazole directly into the powder composition for we have found by experiment that even better results are achieved by this procedure.

Powders have been prepared for the caliber .50 rifle containing as much as 25% aminotetrazole together with nitrocellulose (13.15% nitrogen content) and diphenyl amine as a stabilizer. Such powders have thermochemical properties as determined by heat of explosion and gas volume measurements which are closely akin to the nitrocellulose powders in use for this weapon. Such powders give little or no flash and in addition give only a slight amount of smoke. Other powders have been made for other weapons with equally desirable characteristics. The replacement of some of the nitrocellulose by nitroglycerin or dinitro ethyl benzene or mixtures of the nitro ethyl benzenes as covered in U. S. Patent 1,963,992 gives increased plasticity to such aminotetrazole powders and at the same time renders them resistant to absorption of moisture. It should be emphasized again that incorporation of aminotetrazole does not reduce the ballistic potential of the powder as much as when an inert flash reducing agent is employed.

There follows specific compositions of powder which in proper granulation gave acceptable ballistic results when fired in the caliber .50 rifle and 3" A. A. gun respectively. Flashlessness was obtained with markedly improved smoke effects when compared with standard powders.

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Example I

Nitrocellulose	per cent.	80
5-aminotetrazole	do.	20
Coated with dinitrotoluene.		
Wt. charge	grains	230
Velocity	f. s.	2812
Pressure	p. s. i.	49,800
Cal. .50, Ball M2 bullet.		

Example II

Nitrocellulose	per cent.	82.0
Aminotetrazole	do.	20.0
Dinitro ethyl benzene	do.	8.0
Centralite	per cent added	1.0
Wt. charge	lbs.	4.5
Velocity	f. s.	2800
Pressure	p. s. i.	35,000
3" A. A. gun, M42 projectile.		

This invention, therefore covers propellant powders for use in small arms or cannon, such powders containing aminotetrazole, to provide flashlessness without excessive smoke. The effect of such addition does not decrease the stability of the powders, does not reduce the ballistic potential of such compositions unduly and is unique in offering for use flashless powders which yield a greatly reduced amount of smoke.

We claim:

1. A propellant powder comprising nitrocellulose as the main explosive ingredient and a smaller proportion of 5-aminotetrazole in sufficient amount to impart flashless and smokeless characteristics to the powder.
2. A propellant powder comprising nitrocellulose as the main explosive ingredient and about 20 to 25% of 5-aminotetrazole based upon the weight of the powder.
3. A propellant charge comprising nitrocellulose as the main explosive ingredient and a sufficient amount of 5-aminotetrazole to impart flashless and smokeless characteristics to the charge.
4. A propellant charge comprising nitrocellulose as the main explosive ingredient and about 20% of 5-aminotetrazole based upon the weight of the charge.
5. A propellant charge comprising nitrocellulose as the main explosive ingredient and about 20 to 25% 5-aminotetrazole based upon the weight of the charge.

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