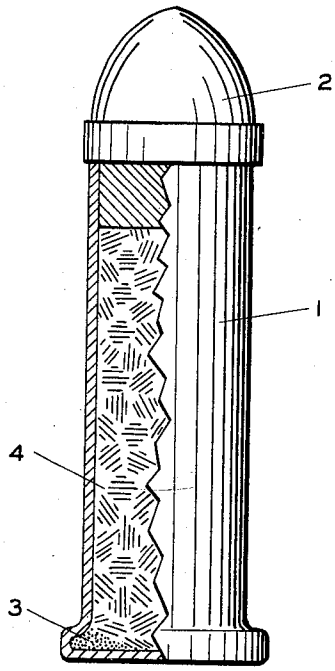
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PROPELLENT POWDER

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PROPELLENT POWDER

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This invention relates to a progressive-burning propellent powder, and more particularly to an unmodified double base smokeless powder of progressive-burning character which is especially suitable for use in high velocity .22 caliber rim-fire ammunition.

It is well known that .22 caliber rim-fire cartridges are loaded with progressive-burning smokeless powder which has characteristics that give certain definite desirable pressure and velocity relations. To obtain these relations when double base powders are used, it is customary to coat the grains of smokeless powder with a deterrent material, which coating so modifies the grains that their initial burning rate is retarded and the powder burns so that successively exposed surfaces contain less and less of the deterrent material and thus the combustion of the grains is caused to proceed with increasing speed. Although modified double base powder grains give excellent ballistics, they are more costly to prepare since their preparation involves extra operations and added ingredients.

Coated powder grains are also subject to several shortcomings, one of which is that the deterrent layer under certain conditions of hot storage may tend to diffuse through the inner portions of the grains. Thus the layer is lost from the surface of the grain giving rise to high initial pressures when the powder is fired. A coated powder requires increased charge weight for the coating agents do not add to the potential of the powder. An unmodified grain therefore is more efficient than a corresponding modified powder.

Now, in accordance with this invention, it has been found that desirable ballistics can be obtained from an unmodified double base powder when it is loaded into .22 caliber rim-fire cartridges if the composition includes certain definite percentages of nitroguanidine, nitroglycerin, and nitrocellulose.

In more detail, it has been found that an admixture containing between about 10 and about 20% nitroglycerin, between about 10 and about 30% nitroguanidine, between about 50 and about 80% nitrocellulose, and the normal amount usually .50 to 1.25% of a stabilizer, when admixed with normal smokeless powder solvents such as ethyl alcohol, ethyl ether and acetone to form a colloided mass, pressed into strands and cut into grains, produces powder grains which when glazed and sieved gave desirable ballistics in .22 caliber rim-fire cartridges. The double base powder grains prepared as above are not surface modified, as the composition when maintained within the percentages indicated gives ballistics that are comparable to standard double base coated powders. The ballistics obtained compare favorably in charge weight, breech pressure, and instrument velocity.

The nature and purpose of this invention have been indicated in a general way. There now follows a more detailed description of a preferred embodiment thereof with reference to the accompanying drawing, in which the single figure represents a .22-caliber rim-fire cartridge.

In the single figure the cartridge includes a metallic casing 1, usually of brass or copper, which has a lead or similar bullet 2 inserted and clamped into its open end. The breech end of the cartridge contains a priming composition 3, which usually consists of a detonating material and an abrasive material. This priming composition is positioned within the annular space formed when the cartridge is upset. In the cartridge casing 1 there is a charge of smokeless powder of the type which has been found useful in the invention. Described hereinafter, the powder consists of grains 4 of an unmodified double-base powder.

To indicate the compositions which when in accordance with this invention are admixed, colloided, pressed, and cut into grains give smokeless powders that are suitable for use in an uncoated condition in .22 caliber rim-fire cartridges, the following examples are given:

EXAMPLE 1

An admixture of 15% nitroglycerin, 10% nitroguanidine, 74.25% nitrocellulose, and .75% diethyldiphenylurea was mixed with an alcohol-acetone solvent mixture in a W and P mixer until colloided to give a substantially uniform powder mass, pressed into strands, and cut into grains. The grains thereafter were dried, glazed, and sieved. The grains were not modified by any type surface coating, but when tested in .22 caliber ammunition gave desirable ballistics.

Other examples similar to the composition of Example 1 were prepared and tested. The various examples with their composition and ballistics when tested in .22 caliber rim-fire cartridges are given in Table 1 below. Each powder is compared to commercial powders coated with standard modifying agents.

TABLE 1

Uncoated nitroguanidine powders compared to coated nitroglycerin powders in .22 cal. rim fire cartridges

Example	Percent nitroglycerin	Percent nitroguanidine	Percent KNO_3	Charge, grains	Mean velocity, ft./sec.	Mean pressure, lbs./sq. in.	Granulation diameter × length in inches	Coating
2	15		.15	2.15	1,305	22,100	.038 × 1/175	Note 1.
	15	30		2.02	1,304	22,900	.041 × 1/98	None.
3	15		.12	2.16	1,307	21,300	.038 × 1/175	Note 2.
	15	20		2.00	1,307	21,400	.038 × 1/175	None.
4	15		.12	2.18	1,302	22,100	.038 × 1/175	Note 2.
	15	10		2.18	1,297	21,300	.038 × 1/150	None.
5	15		.12	2.16	1,271	23,000	.038 × 1/175	Note 2.
	20	30		1.92	1,279	22,300	.041 × 1/175	None.
6	15		.12	2.26	1,306	22,600	.038 × 1/175	Note 2.
	20	10		2.10	1,302	22,200	.041 × 1/175	None.
7	15		.12	2.26	1,293	21,700	.038 × 1/175	Note 2.
	10	30		2.25	1,297	20,900	.041 × 1/123	None.
8	15		.12	2.24	1,293	22,800	.038 × 1/175	Note 2.
	10	20		2.27	1,302	22,500	.041 × 1/175	None.
9	15		.12	2.25	1,295	21,300	.038 × 1/175	Note 2.
	15	20	.50	2.21	1,323	21,600	.038 × 1/150	None.

Bullet.—Remington 40 gr. lead.
Note 1.—Powder coated with diethyl phthalate—2.1%.
Note 2.—Coating.—Ethyl o-benzoyl benzoate 0.9%, butyl phthalyl butyl glycollate 0.9%, substantially petroleum insoluble pine wood resin—Vinsol 0.4%.
Ten shot tests.—Formula.—Nitroguanidine—as indicated; nitroglycerin—as indicated; KNO_3—as indicated; ethyl centralite—0.75%; nitrocellulose (13.21% N)—remainder.

It is seen from the data in Table 1 that the present invention produces powders which are the full equivalent in ballistics of desirable commercial powders without the need of coating the individual grains. Normal nitroglycerin powders containing no nitroguanidine will not give the desirable ballistics unless coated. This difference in coated and uncoated nitroglycerin powders is shown below.

TABLE 2

Comparison of coated and uncoated nitroglycerin powders in .22 cal. rim fire cartridges

Percent nitroglycerin	Percent KNO_3	Charge, grains	Mean velocity, ft./sec.	Mean pressure, lbs./sq. in.	Granulation diameter × length in inches	Coating
15	.12	2.24	1,304	21,700	.038×1/175	Note 1
15	.12	1.73	1,221	21,700	.038×1/175	None

Bullet.—Remington 40 gr. lead.
Note 1.—Coating ethyl o-benzoyl benzoate 0.9%, butyl phthalyl butyl glycollate 0.9%, substantially petroleum insoluble pine wood resin (Vinsol) 0.4%.
Ten shot test.—Formula.—Nitroglycerin—as indicated; KNO_3—as indicated; ethyl centralite—0.75%; nitrocellulose (13.21% N)—remainder.

The nitroguanidine which is used in the powders of this invention may be prepared by sulfuric acid digestion of guanidine nitrate and is a well-known composition in the explosive art. The material is white, crystalline in nature, and is easily purified. The stability thereof is equivalent to the other ingredients used in smokeless powder.

In the preparation of the smokeless powder containing nitroguanidine, some care must be taken to prevent loss of nitroguanidine due to its solubility in cold water. In some instances, water is used in the manufacture of powder, but it is desirable when manufacturing nitroguanidine powder to minimize the exposure of the powder to water or to use water which is saturated with nitroguanidine, thus reducing leaching of the nitroguanidine from the powder grains.

In producing the powders in accordance with this invention, the nitroguanidine will be present between about 10 and about 30% by weight of the composition but the preferable powder for use in .22 caliber rim-fire ammunition contains about 20% nitroguanidine. The nitroguanidine is preferably used in finely divided condition which is the ordinary form in which the compound is obtained.

The nitroglycerin which is used in the powder of this invention is normal smokeless powder nitroglycerin. This nitroglycerin may be used in a range between about 10 and about 20% and the preferable powder of this invention contains 15% by weight nitroglycerin. Nitroglycerin contents greater than about 20% are undesirable because they render the powder grains sticky, preventing easy loading and further cause desensitization of primers during storage.

The nitrocellulose which is used in the powder of this invention is one of the smokeless type, i. e., containing at least about 13% nitrogen and preferably around 13.2% nitrogen. The nitrocellulose content of the powder may be varied over a wide range. In the powder of the present invention, it may be varied from about 50 to about 80%, but is preferably present between about 65 to about 75%.

In all smokeless powders, a stabilizer is used, and in the powder of this invention, a standard stabilizer is also used. In general, stabilizers are added to the powder composition after it is put in the mixer and the added stabilizer usually amounts to about 1% of the composition in the mixer, i. e., approximatley 1 pound of stabilizer

is added for every 99 pounds of powder composition. The powder of the present invention uses approximately the same amount of stabilizer as normal smokeless powder. Further, the stabilizer used can be any of the accepted stabilizers, for example, diphenylamine, diethyldiphenylurea, or the like.

In the mixing procedure, solvents must be used and the solvents used for preparation of the present powder may be any of the standard solvents or mixtures thereof. Alcohol, ether, and acetone are suitable. The present powder, however, is most easily colloided when an acetone/alcohol mixture is used as the solvent.

In some instances, oxidizing agents are added to smokeless powder. These oxidizing agents are materials such as barium or potassium nitrate. If desired, small amounts of such oxidizing agents, i. e., up to about 0.5% may be added to the powder of the present invention. However, the preferable compositions of this invention do not contain such oxidizers.

The granulation of the powders of the present invention runs parallel to the granulation procedures and ranges used to produce the various commercial .22 caliber rim-fire powder. In general, the grains are about .03 to about .04 inch in diameter and between about $^1/_{75}$ to $^1/_{200}$ of an inch in thickness. The granulation, of course, affects the charge weights and the burning speed of the powder but such regulations of the granulation are well within the skill of the art.

The unmodified double base powder of this invention finds its main use in high velocity .22 caliber rim-fire ammunition and in such ammunition it is the full equivalent of coated powders now on the market. The powder of this invention being uncoated has many inherent advantages over coated powders. The uncoated powder is more uniform since there is no question as to even distribution of coating material, is easier to prepare because the coating operation is unnecessary and it is more economical since the manufacturing cycle is reduced by the time necessary to effect coating and the cost thereof. An additional advantage of the present uncoated powder over modified double base powders is that the former are not subject to ballistic changes in hot storage arising from diffusion of a surface coating into the interior portions of the grains.

What I claim and desire to protect by Letters Patent is:

1. Unmodified progressive-burning smokeless powder grains suitable for use in .22 caliber rim-fire ammunition comprising a uniform colloid containing between about 10 and about 20% nitroglycerin, between about 10 and about 30% nitroguanidine, between about 50 and about 80% nitrocellulose, and a stabilizer.

2. Unmodified progressive-burning smokeless powder grains suitable for use in .22 caliber rim-fire ammunition comprising a uniform colloided admixture containing about 15% nitroglycerine, between about 10 and about 30% nitroguanidine, and between about 55 and about 75% nitrocellulose, and between about .5 and about 1.25% of a stabilizer.

3. Unmodified progressive-burning smokeless powder grains suitable for use in .22 caliber rim-fire ammunition comprising a uniform colloided admixture containing about 15% nitroglycerin, about 20% nitroguanidine, about 64% nitrocellulose, and about 1% added stabilizer.

4. A .22 caliber rim-fire cartridge comprising a casing, a priming charge at the rim thereof, a progressive-burning smokeless powder charge, and a metallic bullet, said smokeless powder charge comprising unmodified grains composed of between about 10 and about 20% nitroglycerin, between about 10 and about 30% nitroguanidine, between about 50 and about 80% nitrocellulose, and a stabilizer.

5. A .22 caliber rim-fire cartridge comprising a casing, a priming charge at the rim thereof, a progressive-burning smokeless powder charge, and a metallic bullet, said smokeless powder charge comprising unmodified grains composed of about 15% nitroglycerin, between about 10 and 30% nitroguanidine, and between about 65 an 75% nitrocellulose, and between about .5 and about 1.25% of a stabilizer.

6. A .22 caliber rim-fire cartridge comprising a casing, a priming charge at the rim thereof, a progressive-burning smokeless powder charge, and a metalic bullet, said smokeless powder charge comprising unmodified grains composed of about 15% nitroglycerin, about 20% nitroguanidine, about 64% nitrocellulose, and about 1% added stabilizer.

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