

UNITED STATES PATENT OFFICE.

MODESTO ABELLI, OF TURIN, ITALY, ASSIGNOR TO DINAMITE NOBEL SOCIETE ANONYME.

SMOKELESS EXPLOSIVE.

No. 899,855.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, MODESTO ABELLI, a subject of the King of Italy, and a resident of Avigliana, Turin, Italy, have invented certain new and useful Improvements in Smokeless Explosives, of which the following is a specification.

This invention relates to smokeless powders and explosives, for use either in guns for war or sporting purposes, or for use in blasting; but more especially for use in guns or fire-arms.

For a long time makers of smokeless powder, especially for war purposes and hunting uses, have sought to obtain a product which shall develop the lowest temperature when exploded that is consistent with the maintenance of the greatest ballistic force, in order to reduce to a minimum the erosive effects on the metal of the combustion chamber and bore of the gun.

Several substances have been recognized as correctives, especially in powders which contain nitroglycerin, but up to the present, so far as known, none of these has given results which are really satisfactory, as the greater part of such substances have the effect of diminishing the ballistic force or energy of the powder. In studying this problem I have found nitroguanidin, an amido derivative of carbonic acid, which has the formula $\text{NH}_2\text{C}(\text{NH})\text{NHNO}_2$, and which in certain circumstances, is itself capable of explosion, but which has a very low temperature of explosion. This derivative may be suitably and usefully applied in the manufacture of explosives, and particularly of powder for military and sporting uses, with the important advantage that it diminishes in a marked degree the corrosive effect on the metal of the gun. This substance—nitroguanidin—is eminently stable, unalterable by moderate heat (being decomposed only by a temperature above 200°C .), insensible to shocks and friction, and which contains already, aside from a large quantity of nitrogen, (from 45 to 50 per cent.), nearly the whole of the oxygen necessary to transform it into gas,—is introduced in suitable proportion into the composition of explosives having a base of nitro-cellulose, with or without nitroglycerin. The nitrocellulose may

be substituted wholly or in part by nitrohydrocellulose, nitrated wood, straw, jute, or other substance of a similar kind. Also, the nitroglycerin may be substituted, wholly or in part, by nitrobenzol, nitrotoluol, and other similar compounds, acting the part of fixed solvents, as the nitroglycerin.

Among the different formulæ which respond best in giving to projectiles remarkably high initial velocities with relatively low pressures, and above all with temperatures of explosion so moderate that the corrosion of the metal of the gun is almost wholly eliminated, the following may be given:—

Nitroglycerin,	45 parts by weight.	
Nitrocellulose,	30 " " "	
Nitroguanidin,	25 " " "	70

Excellent results may be obtained also with the following composition:—
In 100 parts by weight:

Nitroglycerin	----	40 or 30 parts.	
Nitrocellulose	----	40 or 45 "	75
Nitroguanidin	----	20 or 25 "	
		100	100

The nitroguanidin is only slightly soluble in cold water, and presents itself in the form of a very fine crystallized powder, and its mixture with the pulped nitrocellulose may be effected in a satisfactory way by any of the known processes employed in the powder factories or mills for making smokeless powder; that is to say, either dry or in suspension in water; also with a volatile solvent or without a solvent. The mixture thus obtained may be very easily gelatinized, with or without the addition of nitroglycerin; or with any of the solvents of nitrocellulose, as acetone, ether, acetic ether, amyl acetate, etc. or likewise without solvents, by means of rolling hot or cold.

The paste obtained with one of the processes above indicated responds to all the exigencies of manufacture of a good powder, capable of being transformed by any one of the systems usually employed (rolling or compression) into strips, leaves, cylindrical threads, bars, cords, tubes or grains of any suitable form or size.

The nitroguanidin may enter with success

into the composition of all explosives having a nitroglycerin base, as well as into the composition of all explosives having as a base oxidizing salts.

- 5 I have ascertained that we may obtain very powerful explosives, though of great insensibility to shocks and friction, by coupling the properties of nitroguanidin, with those of certain explosives already known and well characterized, which are capable of disengaging in their combustion a great number of calories. Thus for example the nitroguanidin may be mixed with picric acid, either when this latter is in a state of fusion (to be more precise, during the act of this fusion) or by a simple mixture of the two substances in a crystalline state, or pulverized, or crystallizing them together from their solution in a common solvent.
- 20 The mixture may be suitably compressed, either alone or after the addition of variable quantities of oxygenating salts (as nitrates, chlorates, perchlorates, chromates, permanganates, etc.). For picric acid we may substitute its salts, or substances appertaining to the different categories of nitroderivatives of the aromatic series. These formulæ may be cited:

20	Nitroguanidin.....	60 or 30
	Potassium or ammonium nitrate.....	20 or —
	Picric acid.....	20 " 20
	Ammonium nitrate.....	— " 40
35	Dinitrotoluol.....	— " 10

- I have also found that the addition to explosives used for mining purposes, of metallic powders such as iron, aluminum, silicon, ferro-silicon, magnesium, zinc, and alloys thereof, will produce explosives of great energy and possessing also great insensibility to shocks and friction. This is due to the high temperature arising from the oxidation of said metals. As examples of such mix-

tures or compounds the following formulæ are given:—

	Nitroguanidin.....	25	
	Ammonium nitrate.....	55	
	Aluminum in fine grains.....	10	
	Dinitrotoluol.....	8	50
	Rosin.....	2	

or, in lieu of this—

	Nitroguanidin.....	15	
	Guanidin nitrate.....	10	
	Potassium (or barium) nitrate.....	20	55
	Ammonium nitrate.....	35	
	Aluminum in fine grains.....	15	
	Nitronaphthalene.....	5	

All the preceding mixtures, either in powder, or granules, after having been more or less strongly compressed, by reason of their stability and their insensibility to shocks and friction, can be usefully employed for charging hollow projectiles, offering in comparison with the explosives now in use a greater security in firing and in the facility with which they may be preserved. To prevent the action of humidity on mixtures prepared with oxygenating salts, we may add a small quantity (say about 5 per cent of the mass of powder) of fatty or oily matter, either vegetable or mineral, or in lieu thereof a resinous substance, as varnish, lacquer, colophony, or any other substance capable of producing a similar effect.

Having thus described my invention, I claim—

A smokeless powder composed of nitroglycerin, nitrocellulose, and nitroguanidin, in substantially the proportions specified.

In witness whereof I have hereunto signed my name this 12th day of October 1905, in the presence of two subscribing witnesses.

MODESTO ABELLI.

Witnesses:

GOTTARDO C. PIRONI,
SECONDO YORTA.