UNITED STATES PATENT OFFICE.

JOHN B. BERNADOU AND GEORGE A. CONVERSE, OF THE UNITED STATES NAVY.

PROCESS OF MAKING NITROCELLULOSE POWDERS.

SPECIFICATION forming part of Letters Patent No. 550,472, dated November 26, 1895.

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To all whom it may concern:

Be it known that we, JOHN B. BERNADOU, lieutenant United States Navy, and GEORGE A. CONVERSE, commander United States Navy, stationed at the naval torpedo station near Newport, Rhode Island, have invented certain new and useful Improvements in the Manufacture of Nitrocellulose Powders of Standard Strength; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to processes for the manufacture of gunpowder from nitrocellulose; and the said invention consists especially in the improved method of manufacturing a powder of uniform or standard strength or of a predeterminable desired uniform strength free from the wide variations that have hitherto been found to exist in the explosive effect of powders manufactured under similar conditions from nitrocellulose and like compounds.

It is known that by dipping cellulose in the form of cotton into nitric acid either concentrated or diluted, or by dipping cellulose into a mixture of concentrated sulphuric and nitric acids or into a mixture of nitric acids and sulphuric acids diluted and subsequently washing and drying the residual product a nitro-substitution product of cellulose is obtained, which product consists of an admixture of some or all of the members of a series of nitro-substitution products into which nitrocellulose can be split up or of which it is formed, and this with or without the accompaniment of free non-nitrated cotton. This series of nitro-substitution products of cellulose is variously defined by different authorities; but the nature of the resultant mixture of nitro-substitution products of cellulose may differ in many ways.

Since the explosive force of any nitrocellulose or of any mixture of nitrocelluloses varies with the amount of oxygen that is introduced into the cellulose along with nitrogen during the conversion of the cellulose into nitrocellulose, and since the amount of this oxygen so introduced is in definite ratio to the amount of nitrogen so introduced, the determination of the amount of nitrogen so introduced will serve to indicate the amount of oxygen introduced. The explosive force of the nitrocellulose may therefore be determined through the chemical estimation of its nitration, or it may be determined experimentally by ballistic tests, the explosive force of powder varying with the velocity of the projectile and with the pressure developed in the bore of the gun.

From the premises supplemented by experiments we have discovered the hereinafter-described method of controlling the explosive force of powders made from nitrocellulose or pyroxylines, so as to produce from a given volume or weight of said nitrocellulose or pyroxyline a predetermined uniform or approximately uniform ballistic effect. To carry out this method we predetermine within the limits of nitration strength of stable nitrocellulose, as determined by chemical analysis, any nitration strength of nitrocellulose or pyroxyline (for the sake of example let us assume N. = 12.75 per cent. of the chemical composition of the nitrocellulose) that we desire to maintain. We then take a nitrocellulose of a nitration strength known to be above the nitration strength that is to be maintained (take, for the sake of example, N. = 13.00 per cent. of the chemical composition of the said nitrocellulose) and mix or blend it with a nitrocellulose of a nitration strength known to be below the nitration strength of nitrocellulose that is to be maintained (take, for the sake of example, N. = 11.50 per cent. of the chemical composition of the said nitrocellulose) in such a manner that the mean nitration strength of the blended or mixed mass equals the predetermined nitration strength (in this case N = 12.75 per cent.) that it is desired to maintain. In this way any desired mean nitration strength of mixtures of two or more grades of nitrocellulose may be obtained by simple computation.

Now if a given weight or volume of blended

or mixed nitrocelluloses be so compounded from two or more nitrocelluloses that compose it as to form a blended or mixed mass of predetermined mean nitration strength, and if the blended or mixed mass so obtained be subsequently reduced to the colloid state by admixture with and subsequent kneading together with a suitable solvent, such as acetone or acetic ether or other solvent capable of dissolving all of the nitrocellulose present so as to form a homogeneous mass of mean nitration strength, and if the colloided mass so obtained be worked into shapes of the same form and dimensions, then equal weights or equal volumes of the colloided shapes so obtained will, if ignited in the bore of a given gun, develop equal or approximately equal explosive effects. Furthermore, if a given weight or volume of these blended nitrocelluloses of predetermined nitration strength be mixed with a suitable oxydizing agent, (such as oxygen-carrying salts of metallic base or of ammonia, such as chlorates, nitrates, sulphates, or carbonates, singly or taken together,) and the whole be colloided and made into powder, then this powder will be of practically-uniform strength, and like charges will in the same gun produce like results. Furthermore, if the blend of nitrocelluloses be combined with non-volatile organic compounds not containing nitrogen, whether with or without an oxidizing agent, and the mixture be colloided and made into powder or in any way be converted into a homogeneous mass and this mass be made into shapes of the same form and dimensions, then equal weights or volumes of these shapes so obtained will, if ignited in the bore of a given gun, develop equal or approximately equal explosive effects.

In brief, the process consists in mixing together two or more nitrocelluloses of known nitration strength in such proportions as to obtain a nitrocellulose product of standard or desired nitration strength, in adding an oxidizing agent and camphor, in colloiding the mass with a solvent capable of dissolving the highest form of nitrocellulose present, and in pressing the colloid mass into plates, sheets, or strips, or regular forms of uniform least dimension of suitable size and shape, and in finally drying the same. The least dimension, which may be called the "thickness" of these sheets or strips, will determine the time of burning of the powder, and will vary according to the length and caliber of the gun for which the powder is intended.

In practice we use barium nitrate as the preferred oxidizing agent in the proportions of about fifteen per cent. of barium nitrate to one per cent. of camphor, to eighty-four per cent. of the nitro-substitution products; but these proportions may be varied within wide limits, and either the barium nitrate or the camphor, or both, may be omitted from the compound.

As typical formula of powders we use—

I.

	Grams.
Torpedo station gun-cotton, lot 160 (N.=13.06 per cent.)	273
Du Pont's soluble nitrocellulose, lot 1 (N.=11.44 per cent.)	64
Parts of mean nitration (N.=12.75 per cent.)	337
Barium nitrate	57
Precipitate of chalk	6
Total	400

II.

Torpedo station gun-cotton, lot 162 (N.=12.89 per cent.)	304
Du Pont's soluble nitrocellulose, lot 1 (N.=11.44 per cent.)	33
Parts of mean nitration (N.=12.75 per cent.)	337
Barium nitrate	57
Precipitate of chalk	6
Total	400

In each case the nitrocelluloses are previously gelatinized with about four hundred cubic centimeters acetone, in which are dissolved about six grams of camphor; but these proportions may be varied within the desired limits.

Moreover, if desired, the explosive effect of the powder so formed may be weakened by the addition of a suitable amount of non-nitrated cellulose or like inert material, or altered by omitting altogether the addition of the oxidizing agent.

Having thus described our invention, what we claim, and desire to secure by Letters Patent of the United States, is—

1. The process of manufacturing an explosive from nitro-cellulose, which consists in blending or mixing together definite amounts of two or more nitro-celluloses, the nitration strength of each of which is different from the mean nitration strength desired, by means of a volatile solvent capable of dissolving the highest form of nitro-cellulose present, and in then drying out said solvent, substantially as described.

2. The process of manufacturing a nitro-cellulose explosive of uniform or approximately uniform ballistic qualities, which consists in so blending a plurality of nitro-celluloses as to obtain a product containing a uniform percentage of nitrogen.

3. The process of manufacturing an explosive from nitro-cellulose, which consists in blending or mixing together definite amounts of two or more nitro-celluloses, the nitration strength of each of which is different from the mean nitration strength desired, in reducing this mass to the colloid state with a solvent capable of dissolving the highest form of nitro-cellulose present, and in separating the colloid mass into regular forms of uniform least dimension, and drying the same, substantially as described.

4. The process of manufacturing an explosive from nitro-cellulose, which consists in blending or mixing together definite amounts of two or more nitro-celluloses the nitration strength of each of which is different from the mean nitration strength desired, in treating this mass with acetone and colloiding the same, in compressing the colloid mass into

regular forms of uniform least dimension, and drying these grains, substantially as described.

5. The process of manufacturing an explosive from nitro-cellulose, which consists in blending together definite amounts of a plurality of nitro-celluloses, the nitration strength of each of which is different from the mean nitration strength desired, in colloiding the mass with a solvent capable of dissolving the highest form of nitro-cellulose present and in incorporating into this mixture an oxidizing inorganic agent, substantially as described.

6. The process of manufacturing an explosive from nitro-cellulose, which consists in blending or mixing together definite amounts of a plurality of nitro-celluloses, in colloiding this mass with a solvent capable of dissolving the highest form of nitro-cellulose present and in incorporating barium nitrate into the mixture, substantially as described.

7. The process of manufacturing an explosive from nitro-cellulose, which consists in blending together definite amounts of a plurality of nitro-celluloses, the nitration strength of each of which is different from the mean nitration strength desired, in colloiding this mass with a solvent capable of dissolving the highest form of nitro-cellulose present and in adding camphor to the mixture, substantially as described.

8. The process of manufacturing an explosive from nitro-cellulose, which consists in mixing definite amounts of a plurality of nitro-celluloses, the nitration strength of each of which is different from the mean nitration strength desired, in adding an oxidizing agent and camphor to the mass, in colloiding the mixture with a solvent capable of dissolving the highest form of nitro-cellulose present, and making the same into regular forms of uniform least dimension, substantially as described.

9. The process of manufacturing an explosive from nitro-cellulose, which consists in blending together definite amounts of a plurality of nitro-celluloses, the nitration strength of each of which is different from the mean nitration strength desired in colloiding this mass with a solvent capable of dissolving the highest form of nitro-cellulose present, and in incorporating into this mixture non-nitrated cellulose, substantially as described.

10. The process of manufacturing an explosive from nitro-cellulose, which consists in blending together definite amounts of a plurality of nitro-celluloses, the nitration strength of each of which is different from the mean nitration strength desired in colloiding this mass with a solvent capable of dissolving the highest form of nitro-cellulose present, and in incorporating into this mixture non-nitrated cellulose, and an oxidizing agent, substantially as described.

11. The process of manufacturing an explosive, which consists in blending together definite amounts of a plurality of nitro-celluloses, the nitration strength of each of which is different from the mean nitration strength desired in colloiding this mass with a solvent capable of dissolving the highest form of nitrocellulose present, and in incorporating into this mixture non-nitrated cellulose and camphor, substantially as described.

12. The process of manufacturing an explosive, which consists in blending together definite amounts of a plurality of nitro-celluloses, the nitration strength of each of which is different from the mean nitration strength desired in colloiding this mass with a solvent capable of dissolving the highest form of nitro-cellulose present, and in incorporating into this mixture non-nitrated cellulose, an oxidizing agent and camphor, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

JOHN B. BERNADOU.
GEORGE A. CONVERSE.

Witnesses:
THOS. BREEPE,
EDWARD W. MEEIKLER.