

UNITED STATES PATENT OFFICE.

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COATED NITROCELLULOSE POWDER AND PROCESS OF MAKING THE SAME.

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To all whom it may concern:

Be it known that I, RICHARD G. WOODBRIDGE, Jr., a citizen of the United States, and a resident of Wilmington, in the county of New Castle and State of Delaware, have invented a certain new and useful Coated Nitrocellulose Powder and Process of Making the Same, of which the following is a specification.

This invention relates to a propellant powder suitable for small arms and ordnance, and it comprises firstly, as a new article of manufacture, nitrocellulose powder grains having a firmly adherent coating of a material comprising an inorganic nitrate, and particularly an easily ignitable propellant, and, secondly, a process of producing the new propellant powder.

Considerable variation not infrequently occurs in the ballistics of apparently similar charges of smokeless powder. The most important of the factors responsible for this defect appears to be a lack of uniformity in ignition.

The object of my invention is to provide a nitrocellulose powder characterized by a marked improvement in ballistic qualities, and especially in the ease and uniformity of ignition.

I have discovered that a powder having the above-mentioned desirable qualities can be produced by applying to the nitrocellulose grains, by means of certain binding agents, an inorganic nitrate or an easily ignitable inorganic explosive containing, for example, barium, or potassium, nitrate, and particularly black powder, which contains charcoal and sulfur in addition to potassium nitrate.

The substances that I have found most valuable as binding agents are those which are non-volatile solvents for nitrocellulose, that is, substances which are capable, especially in their liquid state, of colloiding with the nitrocellulose of the powder grains to be treated. A large number of substances are suitable for this purpose, but the class of substances which I prefer are the nitro-benzenoid hydrocarbons, and especially those which are themselves explosives, such as dinitrotoluene.

The nitrocellulose powder grains to which a coating of the above-described composi-

tion may be applied according to my invention may be made according to any of the known processes of manufacture and may be of different sizes and shapes, such as are obtained by pressing colloided nitrocellulose composition through dies, with or without pins to give perforations, into strings, and then granulating the strings; or as may be made by rolling the colloided nitrocellulose composition into sheets and granulating. Or the nitrocellulose powder grains used may be of the so-called bulk type, which are usually made by a process of manufacture in which grains of nitrocellulose composition are subjected to a partial hardening treatment by means of a solvent mixture, or the nitrocellulose is formed into grains by being agitated in water with a suitable solvent. Or the nitrocellulose powder may be any kind of a mixture of grains obtained by sub-dividing nitrocellulose powder grains by any of several processes of grinding or sub-dividing.

The nitrocellulose powder grains to which my invention is applicable can be made for example from a mixture of nitrocellulose soluble in ether-alcohol (2 parts ether by weight to 1 part alcohol) with nitrocellulose relatively insoluble in ether-alcohol, or may be made from soluble nitrocellulose alone, and may contain, uniformly distributed therethrough, a stabilizer such as diphenylamin, inorganic nitrates, graphite, powdered metals, nitro-compounds, deterrent materials, etc., in varying amounts.

My invention is described more in detail as follows:—

100 parts by weight of nitrocellulose powder grains are mixed in a revolving drum first with about 2 parts of a nonvolatile solvent for nitrocellulose, such as dinitrotoluene, and then with from about 1 to 10 parts of a finely pulverized black powder composition. The dinitrotoluene, which functions as a deterrent as well as a binding agent, may be any one of several isomers, or a mixture of the same obtained by the direct nitration of toluene, but I prefer to use pure dinitrotoluene, *i. e.*, 1-2-4 dinitrotoluene. After the dinitrotoluene and nitrocellulose powder grains have been thoroughly mixed, *i. e.*, in from 5 to 10 minutes, the black powder is added. Heat

is applied in any suitable manner to the outside of the drum or to the jacket of the drum, if so provided, until the mixture of nitrocellulose powder grains, dinitrotoluene and black powder is heated to a temperature slightly above the melting point of the dinitrotoluene. In the case of the 1-2-4 dinitrotoluene, a temperature of about 70° C. is usually sufficient, depending on the purity of the dinitrotoluene. At a temperature of about 70° C. the dinitrotoluene melts and, being a solvent for nitrocellulose, it colloids with the nitrocellulose on the surface of the powder grains and impregnates the same to a substantial distance, while the black powder composition is in part firmly cemented to the surface of the powder grains, forming an exterior coating, and is also in part at the same time, and to a considerable extent, carried into the pores of the nitrocellulose colloid. In this manner the black powder composition is so firmly attached to the smokeless powder grains that it is essentially an integral part of the powder and cannot be completely removed without destroying the powder grains.

I do not limit myself to the use for every 100 parts of nitrocellulose powder grains of about two parts dinitrotoluene and from about 1 to 10 parts of black powder composition, as it is evident that the amount of black powder and dinitrotoluene would necessarily be varied according to the ballistics desired. In place of dinitrotoluene I may use as non-volatile solvents for nitrocellulose, other aromatic nitrohydrocarbons, and especially those which are deterrents, such as mononitronaphthalene, or aromatic amids such as phenylacetanilid, dimethyldiphenylurea, etc., but in case of a non-volatile solvent such as dimethyldiphenylurea with a relatively high melting point of 120° to 121° C., when pure, I prefer to add to this 25% or more of dinitrotoluene in order to obtain a mixture with a melting point considerably below 100° C.

Furthermore, while I prefer to use a non-volatile solvent for nitrocellulose as a binding agent for the black powder composition in the manner above described, I have found that other binding agents such as diphenylamin, rosin, etc., may be used, which, while not solvents for nitrocellulose can be melted at a temperature which has no injurious effect on the stability of the powder. While diphenylamin and rosin are not solvents for nitrocellulose and do not impregnate the surface of the powder grains in the same manner as dinitrotoluene and other solvents for nitrocellulose, they are to a certain extent carried into the pores of the powder grains and thereby serve as a fairly satisfactory binding agent to bind the black powder composition to the surface of the nitrocellulose grains. Both diphenyl-

amin and rosin are stronger deterrents than dinitrotoluene so that a given quantity of either of the former will have more effect on the ballistics of the powder than a larger quantity of the latter.

The black powder which I prefer to use is the kind generally used for black sporting powder and has approximately the following composition: 74.0% saltpeter, 10.4% sulfur, 15.6% charcoal.

However, I do not limit myself to any particular composition or degree of granulation of black powder as it is evident that I would use that composition which by test gives the best results, and likewise that granulation which by tests is found most suitable for the particular purposes desired. In general, I prefer to use black powder meal. Also, I do not limit myself to the use of black powder or to the use of black powder containing saltpeter since I have found that many nitrate mixtures, such as a mixture of barium and potassium nitrates, and many nitrates alone such as potassium nitrate, can be applied to the powder grains by my process so as to give improved ballistic qualities to the powder grains, as indicated by easier and more uniform ignition and by cleaner burning of the powder.

I claim:

1. The process of coating nitrocellulose powder grains with an easily ignitable inorganic explosive which comprises applying the latter to said grains in the presence of a non-volatile binding agent meltable at a temperature which has no injurious effect on the stability of the powder, while heating the above mentioned materials to a temperature slightly above the melting point of the binding agent.

2. The process of coating nitrocellulose powder grains with an easily ignitable inorganic explosive comprising a metal nitrate which comprises applying the latter to said grains in the presence of a non-volatile binding agent meltable at a temperature which has no injurious effect on the stability of the powder, while heating the above mentioned materials to a temperature slightly above the melting point of the binding agent.

3. The process of coating nitrocellulose powder grains with black powder which comprises applying the latter to said grains in the presence of a non-volatile binding agent meltable at a temperature which has no injurious effect on the stability of the powder, while heating the above mentioned materials to a temperature slightly above the melting point of the binding agent.

4. The process of coating nitrocellulose powder grains with a black powder composition which comprises heating a mixture of said powder grains, said black powder composition, and a non-volatile solvent for ni-

trocellulose at a temperature sufficient to melt said non-volatile solvent and to cause the same to colloid with the nitrocellulose of the powder grains.

5 5. The process of coating nitrocellulose powder grains with black powder composition by heating a mixture of said powder grains, black powder composition and dinitrotoluene at a temperature sufficient to melt said dinitrotoluene and to cause the same to colloid with the nitrocellulose of the powder grains.

15 6. The process of coating nitrocellulose powder grains with black powder composition by heating a mixture of said powder grains, black powder composition and substantially pure 1-2-4 dinitrotoluene at a temperature sufficient to melt said 1-2-4 dinitrotoluene and to cause the same to colloid with the nitrocellulose of the powder grains.

25 7. The process of coating nitrocellulose powder grains with black powder composition by heating a mixture of said powder grains, black powder composition and a deterrent material, which is a non-volatile solvent for nitrocellulose, at a temperature sufficient to melt said deterrent material and to cause the same to colloid with the nitrocellulose of the powder grains.

30 8. The process of coating nitrocellulose powder grains with black powder composition by heating a mixture of said powder grains, black powder composition and a binding agent at a temperature sufficient to melt or soften said binding agent.

35 9. The process of coating nitrocellulose powder grains with an inorganic nitrate which comprises heating a mixture of said powder grains, said inorganic nitrate, and a binding agent at a temperature sufficient to melt or soften said binding agent.

40 10. The process of coating nitrocellulose powder grains with potassium nitrate which comprises heating a mixture of said powder grains, said inorganic nitrate, and a binding agent at a temperature sufficient to melt or soften said binding agent.

45 11. A propellant powder comprising nitrocellulose powder grains having a firmly adherent coating of an easily ignitable inorganic explosive.

50 12. A propellant powder comprising nitrocellulose powder grains having a firmly adherent coating of an easily ignitable propellant comprising potassium nitrate.

55 13. A propellant powder comprising nitrocellulose powder grains having a firmly adherent coating of black powder.

60 14. A propellant powder comprising nitrocellulose powder grains and an easily ignitable propellant held to said grains by a non-volatile binding agent meltable at a temperature that has no injurious effect on the stability of the powder.

15. A propellant powder comprising nitrocellulose powder grains and an easily ignitable propellant held to said grains by a non-volatile binding agent meltable at a temperature that has no injurious effect on the stability of the powder, and capable, when melted, of dissolving nitrocellulose.

16. A propellant powder comprising nitrocellulose powder grains and an easily ignitable inorganic explosive held to said grains by a non-volatile nitrocellulose-solvent which is itself an explosive.

17. A propellant powder comprising nitrocellulose powder grains and an easily ignitable inorganic explosive held to said grains by a non-volatile nitrocellulose-solvent which is an explosive deterrent.

18. A propellant powder comprising nitrocellulose powder grains and a black powder composition held to said grains by a non-volatile nitrocellulose-solvent which is a deterrent.

19. A propellant powder comprising nitrocellulose powder grains and an inorganic nitrate held to said grains by a deterrent material which is a solvent for nitrocellulose.

20. A propellant powder comprising nitrocellulose powder grains and an inorganic nitrate held to said grains by dinitrotoluene.

21. A propellant powder comprising nitrocellulose powder grains having a coating of black powder held to the surface of the grains by an aromatic nitro-hydrocarbon capable of colloidizing with nitrocellulose.

22. A propellant powder comprising nitrocellulose powder grains having a coating of black powder held to the surface of the grains by a nitrobenzenoid hydrocarbon.

23. A propellant powder comprising nitrocellulose powder grains having black powder firmly attached to the surface of said grains by a dinitro-benzenoid hydrocarbon.

24. A propellant powder comprising nitrocellulose powder grains having a substance comprising potassium nitrate firmly attached to the surface of said grains by a dinitro-benzenoid hydrocarbon.

25. A propellant powder comprising nitrocellulose powder grains having a substance comprising potassium nitrate firmly attached to the surface of said grains by a dinitrotoluene.

26. A propellant powder comprising nitrocellulose powder grains having a substance comprising potassium nitrate firmly attached to the surface of said grains by substantially pure 1, 2, 4-dinitrotoluene.

27. A propellant powder comprising parts of nitrocellulose powder grains and from about 1 to 10 parts of black powder held to the surface of said grains by a non-volatile solvent for nitrocellulose.

28. A propellant powder comprising parts of nitrocellulose powder grains and from about 1 to 10 parts of black powder

held to the surface of said grains by about 2 parts of a non-volatile solvent for nitrocellulose.

29. A propellant powder comprising 100 parts of nitrocellulose powder grains and from about 1 to 10 parts of black powder held to the surface of said grains by about 2 parts of dinitrotoluene.

30. A propellant powder comprising 100 parts of nitrocellulose powder grains and 10 from about 1 to 10 parts of black powder held to the surface of said grains by a deterrent material which is capable of colloidizing with nitrocellulose.

In testimony whereof I affix my signature. 15
RICHARD G. WOODBRIDGE, JR.