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METHOD OF MANUFACTURE OF SMOKELESS POWDER

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This invention relates to smokeless powder and method of manufacture thereof, and particularly to colloided double base smokeless powder and method of manufacture thereof.

Heretofore, in the manufacture of double base smokeless powder, it has been the practice to remove water from the wet nitrocellulose employed, by passing commercial, denatured ethyl alcohol through a compressed cake of nitrocellulose, usually forced through the nitrocellulose under high pressure, in order to sweep the water from the nitrocellulose and replace the water with denatured ethyl alcohol, leaving the nitrocellulose wet with the denatured ethyl alcohol.

The cake of nitrocellulose is then broken up into a fine powder, for example, by a suitable breaker, and mixed with nitroglycerine, acetone, and some more denatured ethyl alcohol, the whole thoroughly mixed to start the colloiding action, then pressed in a preliminary press to complete the colloiding of the nitrocellulose and form the colloid into large cylinders, which cylinders are then put in a final press and extruded through a multiple orifice into strands, which are then cut into grains by revolving knives, dried and glazed.

In place of the acetone, ether, or mixtures of ether and acetone, have also been used. The denatured alcohol used heretofore in the operation referred to above is known as 2B denatured ethyl alcohol, and contains one-half a gallon of benzene per 100 gallons of 92% by weight alcohol. The acetone and ether heretofore used have been substantially anhydrous.

In the case of colloided double base smokeless powders prepared as described above, and which may contain, in addition to the nitrocellulose, various ingredients such as nitroglycerine, diphenylamine, dimethyldiphenylurea, potassium nitrate, barium nitrate, and the like, it has been found that this use in firearms at low temperatures has resulted in the production of excessive breech pressures. For example, in the firing of such colloided double base smokeless powders at prevailing temperatures of —40° F., many rifles have burst. Tests of firing such rifles loaded with such colloided double base smokeless powders at —40° F. have shown that the normal breech pressure, shown at ordinary temperatures and amounting to 40,000–55,000 lbs. per square inch has been raised to the dangerous pressure of 55,000 to 70,000 lbs. per sq. in.

While not capable of satisfactory proof, I attribute this abnormal rise in breech pressure of guns fired at low temperatures to the embrittling action of low temperatures on the colloided double base smokeless powder in such ammunition. When the primer of a cartridge is fired, the charge of smokeless powder in the cartridge receives a severe shock and is projected violently against the base of the bullet, tending to break grains of powder which are brittle. Broken grains of powder are necessarily of finer size than original grains, and broken grains consequently burn faster and develop higher pressures in the gun.

I have found that this disadvantage of abnormal rise in barrel pressures on firing at low temperatures can be almost completely avoided by the use of colloided double base smokeless powders which have been colloided by the use of an anhydrous alcohol such as ethyl alcohol or iso-propyl alcohol, in place of the same alcohols heretofore used but containing substantial amounts of water, such as for example, 92% or 95% by weight of ethyl alcohol or 88% by weight of iso-propyl alcohol, and substantially anhydrous acetone or ether, or mixtures thereof. I am unable to explain definitely the reason for this improvement in the smokeless powders so produced, but believe that it is due to the production of a tougher, less brittle colloid in my improved powders.

As an example of my improved process and product, 77.25 parts by weight of nitrocellulose, dry basis, and containing 13.22% nitrogen, and ether-alcohol solubility of 30.75%, and containing 15 parts by weight of anhydrous ethyl alcohol (remaining in the nitrocellulose, for example, from the dehydration of the nitrocellulose by anhydrous ethyl alcohol) is thoroughly mixed with 0.75 part by weight of diphenylamine, 1.5 parts by weight of barium nitrate, 0.50 part by weight of potassium nitrate, 22 parts by weight of anhydrous acetone, and 20 parts by weight of nitroglycerine in a covered mixer which may be water-cooled, then further colloided by pressing in a preliminary press extruding from said preliminary press, pressed in a final press through a .045" die having a .010" pin into strands, the strands cut into grains (11 to the inch), the solvent removed by air- or water-drying, and glazed. The finished powder when fired in a rifle at a temperature of —54° F. gives a breech pressure of about 1100 pounds per square inch more than when fired at normal temperature, whereas a smokeless powder made the same way by the use of ordinary ethyl alcohol gives a rise in pressure of 5600 pounds per square inch.

As a further example of my improved process

and product, 237.8 parts by weight of dry nitrocellulose containing 13.22% nitrogen and ether-alcohol solubility of 30.75% is thoroughly mixed with 2.20 parts by weight of diphenylamine, 60 parts by weight of nitroglycerine, 70 parts by weight of anhydrous ethyl alcohol, and 140 parts of anhydrous ether and finished as in the above example. The finished powder when fired in a rifle at a temperature of about —58° F. gives a breech pressure of about 9700 pounds per square inch higher than when fired at normal temperature, whereas a smokeless powder made in the same way with the use of ordinary ethyl alcohol gives a rise in pressure of 17,100 pounds per square inch.

As a further example of my improved process and product, 237.8 parts by weight of dry nitrocellulose is mixed with 2.20 parts by weight of symmetrical diethyldiphenylurea, 60 parts by weight of nitroglycerine, 40 parts by weight of anhydrous ethyl alcohol, 106 parts by weight of anhydrous ether, and 35 parts by weight of anhydrous acetone. The powder is finished as in the above examples. The finished powder when fired in a rifle at about —58° F. gives pressures about 13,800 pounds per square inch higher than when fired at normal temperatures, whereas a smokeless powder made in the same way with the use of ordinary ethyl alcohol gives a rise in pressure of 17,900 pounds per square inch at the same low temperatures.

As a further example of my improved process and product, 396 parts by weight of dry nitrocellulose is mixed with 3.7 parts by weight of diphenylamine, 100 parts by weight of a mixture of 55% nitroglycerine and 25% ethylene glycol dinitrate and 20% diethylene glycol dinitrate, and 66 parts by weight of anhydrous ethyl alcohol and 110 parts by weight of anhydrous acetone. The powder is finished as in the above examples and coated with 1% of dinitrotoluene. The finished powder when fired in a rifle at a temperature of —58° F., gives a breech pressure of about 6200 pounds per square inch higher than when fired at normal temperature, whereas a smokeless powder made in the same way by the use of ordinary ethyl alcohol gives a rise in pressure of 10,600 pounds per square inch when fired at the same low temperatures.

As a further example of my improved process and product, 337 parts by weight of dry nitrocellulose containing 13.22% nitrogen, with an ether-alcohol solubility of 30.75%, is thoroughly mixed with 2.3 parts by weight of diphenylamine, 60 parts by weight of nitroglycerine, 70 parts by weight of anhydrous isopropyl alcohol and 68 parts by weight of anhydrous acetone. The powder is then pressed into strands, granulated and finished as in the examples above. The finished powder when fired in a rifle at about —45° F. gives a breech pressure about 1800 pounds per square inch higher than when fired at normal temperatures, whereas a smokeless powder made in the same way except that the iso-propyl alcohol used contained about 9.6% by weight of water, gives a breech pressure about 4600 pounds per square inch higher than when fired at normal temperatures.

It will be appreciated that my invention involves, broadly, the colloiding of nitrocellulose to form double base smokeless powders by the use of anhydrous mixtures of ethyl alcohol or of iso-propyl alcohol and ethyl ether, or of the aforementioned alcohols and acetone, or of mixtures of the three, and the smokeless powder produced thereby, and that my invention is not limited to any particular type of colloided double base smokeless powder or any particular size and shape of grain, and that my invention is not limited to the examples given above.

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

1. In the manufacture of colloided, double base smokeless powders, the step of colloiding nitrocellulose at ordinary temperatures by a mixture consisting of anhydrous solvents for the nitrocellulose.

2. In the manufacture of colloided, double base smokeless powder, the step of colloiding nitrocellulose at ordinary temperature by a mixture consisting of anhydrous ethyl alcohol, anhydrous ethyl ether and an explosive plasticizer.

3. In the manufacture of colloided, double base smokeless powder, the step of colloiding nitrocellulose at ordinary temperature by a mixture consisting of anhydrous ethyl alcohol, anhydrous acetone and an explosive plasticizer.

4. In the manufacture of colloided, double base smokeless powder, the step of colloiding nitrocellulose at ordinary temperature by a mixture consisting of anhydrous iso-propyl alcohol, anhydrous acetone and an explosive plasticizer.

5. Process of manufacture of double base smokeless powder consisting of admixing with nitrocellulose, nitroglycerine, a smokeless powder stabilizer, an inorganic nitrate, and an anhydrous mixture of ethyl alcohol and acetone, colloiding said mixture by kneading at ordinary temperatures, pressing said colloid into strands, cutting said strands into grains, and drying said grains.

6. Process of manufacture of double base smokeless powder consisting of admixing with nitrocellulose, nitroglycerine, a smokeless powder stabilizer, an inorganic nitrate, and an anhydrous mixture of iso-propyl alcohol and acetone, colloiding said mixture by kneading at ordinary temperatures, pressing said colloid into strands, cutting said strands into grains, and drying said grains.

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