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SMOKELESS EXPLOSIVE POWDER.

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In applications filed by us April 24, 1920 (as Serial No. 376,267), and January 24, 1919 (as Serial No. 272,857), we have set forth smokeless explosive ordnance powders with a progressively increasing rate of burning which, when used as a propellant in a gun, very materially reduce, or approximately eliminate, the muzzle flash. These explosives comprise a colloided mass of nitrocellulose containing one-half of one per cent to twenty per cent of particles of a flame propagating agent so thoroughly distributed throughout the mass that it carries the flame from the exposed surfaces, through a multitude of minute channels, into the interior of the powder grains, thereby effecting a progressively accelerating combustion by bringing all the particles of the colloided nitrocellulose much more speedily into contact with the fire and effecting an earlier complete consumption of the powder than is the case where reliance is had solely upon the usual large and relatively coarse mechanical perforation employed in this type of ordnance powder. In this invention another type of burning is superimposed upon that afforded by these mechanical perforations. The acceleration of burning is such that the powder is substantially consumed, that is, combustion and heat development substantially cease, before the gaseous mass emerges from the muzzle of the gun. The work done and the expansion cool substantially the emerging gun mass and flash does not occur. The flame propagating agents disclosed in said applications have the property of much expediting the consumption of the nitrocellulose without materially increasing the chamber pressure (thus avoiding erosion of the gun barrel), without seriously fouling the gun and without excess of smoke. The said applications, in addition to disclosing certain operable flame propagating agents and the proportions thereof necessary or advisable to use, disclose a practicable process of incorporating the ingredients; this process in substance consisting in making an intimate mechanical mixture of nitrocellulose and the agent and then colloiding the nitrocellulose to convert it into an integral or continuous mass enclosing the particles of said agent.

The specific materials that we have heretofore found to be capable of effective use as flame propagating agents and which are disclosed in said applications are ordinary black meal powder, or a mixture of barium nitrate and potassium nitrate.

While the characteristics of these two fire propagating agents are quite dissimilar, the first, for example, being a complete explosive, while the latter has an excess of oxygen, both agents are thoroughly efficient to accomplish the objects sought, namely, that of preventing flash with a nitrocellulose explosive containing them.

The object of the present invention is to provide a flame propagating agent having the functions and advantages of the specific propagating agents disclosed in said applications and which will have the additional advantage of rendering the explosive more stable.

We have discovered that by the use of a mixture of potassium bichromate and charcoal, incorporated with the nitrocellulose by means of the process described in the said applications, a "flashless" smokeless propellent explosive ordnance powder is produced that fully attains the object sought. We have also discovered that potassium bichromate alone is effective to secure the results desired, so that the addition of charcoal is not essential, although it has the advantage of taking up the excess of oxygen in the flame propagating agent if that excess be deemed undesirable. That is, potassium bichromate, when used alone, has the quality, in common with a mixture of barium nitrate and potassium nitrate, of evolving a certain amount of oxygen. When charcoal is added in sufficient proportion to potassium bichromate, the oxygen content of the mixture is balanced out by the carbon added and the mixture corresponds to black powder; which we have found an efficient agent.

The finished explosive, containing potassium bichromate, with or without charcoal, as the flame propagating agent, is more stable than the same explosive containing either a mixture of potassium nitrate and barium nitrate, or black powder, as the flame propagating agent; so that it will be understood that the present invention involves not merely the discovery of a flame propagating agent that can be substituted

for those heretofore described by us, but produces a "flashless" smokeless powder that is actually an improvement upon the specific "flashless" explosive powders set forth in our said prior applications.

The method of manufacture is, preferably, the same as that described in said prior applications. The flame propagating agent is added to soluble nitrocellulose, wetted with about thirty per cent of a suitable liquid, such as water or gasoline, to facilitate blending, and incorporated therewith in a standard black powder wheel mill. This results in a mechanical mixture of the two bodies. The added liquid is then expelled by drying or otherwise. The colloiding agents, ether and alcohol, are then added and the entire mixture is thoroughly colloided in a kneading machine. After the powder has been formed into grains of the usual type employed in ordnance, a considerable proportion of alcohol and ether is distilled off, a certain proportion remaining in the finished product. Care should be taken to avoid removing the alcohol and ether in any way which would remove the fire propagating agent, as that would produce mere porosity in the finished product. Porosity, or porosity alone, is not desired, but what is desired, and what is secured by the foregoing process, is a proper dissemination of the fire propagating agent throughout the colloided mass of the nitrocellulose.

The flame propagating agent may constitute from one to fifteen per cent of the entire explosive. Where potassium bichromate alone is used as the flame propagating agent, it is not desirable that its proportion should exceed ten per cent. About five per cent is preferred. Where a mixture of potassium bichromate and charcoal is used, while there is no objection to the use of as high as fifteen per cent of the mixture, about four per cent is preferred. In this mixture we prefer to use a preponderating proportion of potassium bichromate. Seventy-five per cent of the latter and twenty-five per cent of charcoal have been found efficacious. The proportion of charcoal in the mixture incorporated into the nitrocellulose may be increased to as high as fifty per cent and may be reduced to as low as about eight per cent. A substantially smaller proportion of charcoal would not provide sufficient carbon to balance the oxygen content. Wood charcoal is preferred.

Where in the claims, we mention "colloided" nitrocellulose, we use that term in the sense in which it is ordinarily used by those skilled in the art, namely: nitrocellulose which has been dissolved to a solution and the solution evaporated, leaving the nitrocellulose in a condition physically entirely different from that which it had before solution.

Having now fully described our invention, what we claim and desire to protect by Letters Patent is:

1. A "flashless" smokeless propellent powder which comprises a preponderating proportion of completely colloided nitrocellulose containing a relatively small proportion of a flame propagating agent comprising potassium bichromate uniformly distributed throughout the mass of the nitrocellulose.

2. A "flashless" smokeless propellent powder which comprises a preponderating proportion of colloided nitrocellulose containing a relatively small proportion of potassium bichromate and charcoal distributed throughout the mass of the nitrocellulose.

3. A "flashless" smokeless propellent powder which comprises from eighty-five to ninety-five per cent of completely colloided nitrocellulose containing from one to fifteen per cent of a flame propagating agent comprising potassium bichromate uniformly distributed throughout the mass.

4. A "flashless" smokeless propellent powder which comprises from eighty-five to ninety-nine per cent of colloided nitrocellulose containing from one to fifteen per cent of a mixture of potassium bichromate and charcoal.

5. A "flashless" smokeless propellent powder which comprises a preponderating proportion of colloided nitrocellulose having distributed throughout its mass a relatively small proportion of a flame propagating agent, the latter comprising a preponderating proportion of potassium bichromate and a relatively small proportion of charcoal.

In testimony of which invention, we have hereunto set our hands, at Wilmington, Delaware, on this 18th day of February, 1921.

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