# UNITED STATES PATENT OFFICE.

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## SMOKELESS GUNPOWDER.

SPECIFICATION forming part of Letters Patent No. 701,591, dated June 3, 1902.

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*To all whom it may concern:*

Be it known that I, CARL OLOF LUNDHOLM, a subject of the King of Great Britain, residing at Stevenston, in the county of Ayr, Scotland, have invented certain new and useful Improvements in Smokeless Gunpowders, of which the following is a specification.

The present invention relates to smokeless gunpowders of the class which are called "nitroglycerin powders"—that is to say, powders which contain nitroglycerin in a greater or less degree and nitrocellulose.

The introduction of nitroglycerin powders, which were first brought into notice by Alfred Nobel about the year 1887, marked an era in the history of propulsive explosives, for by the combination of nitroglycerin with nitrocellulose there were produced powders very much cheaper than those up till that time known, but, more important still, powders giving particularly high velocities with low pressures, having exceedingly high energy per unit of weight and a singularly high ballistic stability, together with a perfectly satisfactory chemical stability. The sole point on which they have been found to be in any way inferior to the nitrocellulose powders is that the temperature of their explosion-gases is higher and has been found to cause excessive erosion, especially in the larger kinds of ordnance. Many attempts have been made to remedy this defect, some by mere reduction of the percentage of nitroglycerin, which, however, if carried to any considerable extent creates difficulty as to the removal of the last percentages of solvent, thus causing ballistic instability. Other attempts have gone in the direction of varying the percentages of organic substances, with the object, among other things, of increasing the percentage of carbon and hydrogen in relation to oxygen, and thus reducing the temperature of the explosion-gases. As examples of such additions may be mentioned bi and tri nitrobenzol, toluol, naphthalene, &c., organic esters, such as amyl succinate, cellulose, acetates, butyrates, &c., vaseline, oxalate of ammonia, &c. I have experimented with a large number of substances not hitherto proposed, but all showed one defect or another.

After long investigation I have succeeded by the addition of diamyl phthalate in producing nitroglycerin-nitrocellulose powders which besides being cheap have all the good qualities of their class in respect of high velocity for low pressure, while they have the advantage of giving a low heat and a high gas evolution.

As showing the relation of the improved nitroglycerin powders to those at present known I give the undernoted figures:

| | Calories, per gram. | Total gas volume at 0° C. and 760 min. pressure ccs., per gram. |
|---|---|---|
| Ordinary cordite. | | |
| 37 per cent. nitrocellulose<br>5 per cent. mineral jelly<br>58 per cent. nitroglycerin | 1,248 | 885 |
| *1. Improved Nitroglycerin Powder.* | | |
| 30 per cent. nitroglycerin<br>60 per cent. nitrocellulose<br>5 per cent. diamyl phthalate<br>5 per cent. mineral jelly | 853 | 1,007 |
| *2. Improved Nitroglycerin Powder.* | | |
| 30 per cent. nitroglycerin<br>60 per cent. nitrocellulose<br>10 per cent. diamyl phthalate | 893 | 980 |

I have found the substance diamyl phthalate to be of particularly high chemical stability, and, as I have already mentioned, its use in these powders gives them particularly advantageous ballistic properties without in any way detracting from their physical or chemical stability. The substance can be added in any suitable way—for instance, by dissolving it in nitroglycerin or the volatile facilitating solvent or adding it to the nitrocellulose. The powders are made in the same way as the well-known ballistite and cordite.

The proportions of the several ingredients used in these powders may be to some extent varied. I have obtained very good powders from the following compositions: nitroglycerin, thirty; nitrocellulose, sixty; diamyl phthalate, ten, or nitroglycerin, thirty; nitrocellulose, sixty; mineral jelly, five; diamyl phthalate, five.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A smokeless gunpowder in which nitroglycerin, nitrocellulose and diamyl phthalate are combined, substantially as herein described.

2. A smokeless gunpowder consisting of nitroglycerin, nitrocellulose, mineral jelly and diamyl phthalate, substantially as herein described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CARL OLOF LUNDHOLM.

Witnesses:
ALEXANDER FORBES,
H. M. MURDOCK.