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2,704,706

## EXPLOSIVE COMPOSITION

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This invention relates generally to explosives, and particularly to explosives of the character wherein ammonium nitrate is the principal component.

Ammonium nitrate as an explosive is well known to be difficult to detonate. In the prior practice of manufacturing ammonium nitrate explosives, it has been necessary, in order to detonate the ammonium nitrate, that it be mixed with T. N. T. or other sensitizers. In United States Patent No. 1,827,675, it is proposed to mix with the ammonium nitrate "a sulphur-free derivative of a nitrogen-hydrogen compound in which at least one of the hydrogen atoms has been replaced by an aromatic ring," and a considerable number of such aromatic ring compounds are there suggested. Many such proposals have heretofore been made for improving the sensitivity of ammonium nitrate, but the sensitivity of ammonium nitrate explosives has continued to be less than the desideratum.

The object of the present invention, generally stated, is to increase the sensitivity and detonation rate of ammonium nitrate explosives.

The present invention is predicated upon the discovery that explosives which contain ammonium nitrate as their principal component have their sensitivity improved, and their detonation rate increased, by incorporating hydrazine mono-nitrate with the ammonium nitrate. Any of the ammonium nitrate explosives of commerce exhibit improved sensitivity and increased detonation rate when hydrazine mono-nitrate is incorporated therewith. The introduction of 2 per cent of hydrazine mono-nitrate into an ammonium nitrate explosive markedly increases both the sensitivity and the detonation rate. While the sensitivity and detonation rate increase as the content of hydrazine mono-nitrate is increased, the improvement accomplished by the addition of 5 per cent of hydrazine nitrate renders the explosive quite satisfactory, and 10 per cent of hydrazine mono-nitrate still further improves the detonation rate and sensitivity. Hydrazine mono-nitrate contents above 10 per cent do not significantly improve the explosive.

As illustrating the improvement accomplished by the introduction of hydrazine mono-nitrate into an ammonium nitrate explosive, a typical ammonium nitrate explosive of commerce was modified by the replacement therein of a fraction of ammonium nitrate content with hydrazine mono-nitrate, and the detonation rate and gap sensitivity of the original and modified explosives compared. In the following table, column A indicates the composition of a typical ammonium nitrate explosive of commerce, while columns B and C indicate the modification of explosive A in accordance with the present invention.

|                                                             | A     | B      | C      |
|-------------------------------------------------------------|-------|--------|--------|
| NH <sub>4</sub> NO <sub>3</sub> .....percent..              | 88.5  | 83.5   | 78.5   |
| N <sub>2</sub> H <sub>4</sub> HNO <sub>3</sub> .....do..... | 7.5   | 5.0    | 10.0   |
| TNT.....do.....                                             | 7.5   | 7.5    | 7.5    |
| Chalk.....do.....                                           | 0.5   | 0.5    | 0.5    |
| Aluminum Dust.....do.....                                   | 0.5   | 0.5    | 0.5    |
| Coal.....do.....                                            | 3.0   | 3.0    | 3.0    |
| Detonation Rate (ft. per sec.)                              | 9,750 | 11,420 | 12,490 |
| Gap Sensitivity (inches).....                               | 1-1½  | 3-3½   | 4½-5   |

In preparing the explosives of the present invention, the hydrazine mono-nitrate and ammonium nitrate are preferably mixed with each other prior to introduction of

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the other ingredients into the formula. Particularly desirable results are achieved by fusing the ammonium nitrate and hydrazine mono-nitrate together, then solidifying and subdividing before incorporation of the other ingredients. The melting point of ammonium nitrate is somewhat higher than the melting point of hydrazine mono-nitrate, and consequently no additional hazard is introduced into the fusing operation over that encountered in the usual fusing of ammonium nitrate. Moreover, ammonium nitrate and hydrazine mono-nitrate readily fuse into a homogeneous mixture, where the proportions of hydrazine mono-nitrate do not exceed that of ammonium nitrate. Mixtures containing from 0.02 to 1.0 part of hydrazine mono-nitrate to each part of ammonium nitrate readily fuse into a homogeneous mass which, upon solidification, yields crystals of ammonium nitrate-hydrazine nitrate complex. Similarly, the ammonium nitrate-hydrazine nitrate crystals may be coprecipitated from water solutions.

As a further alternative, granular ammonium nitrate may be coated with hydrazine mono-nitrate to increase the sensitivity of the ammonium nitrate without, however, so decidedly affecting the detonation rate as when the materials are crystallized together.

In lieu of the techniques hereinbefore suggested, the ammonium nitrate may be mixed dry with hydrazine mono-nitrate and the other ingredients. Indeed, in the specific examples given above, the ingredients were mixed dry.

From the foregoing disclosure, those skilled in the art should readily understand that the invention accomplishes its object and provides a means of sensitizing ammonium nitrate explosives so as to achieve control not only of the sensitivity, but also of the detonation rate thereof. While several modes of associating the ammonium nitrate with the hydrazine mono-nitrate have been suggested hereinbefore, for the purpose of illustration, it is not to be understood that the invention is limited to accomplishing such association in the precise modes described. It is, therefore, to be distinctly understood that the incorporation with an ammonium nitrate explosive of that amount of hydrazine mono-nitrate which yields the desired sensitivity and detonation rate is contemplated by the present invention irrespective of the procedure adopted for accomplishing the incorporation.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. A composition of matter prepared for use as an explosive consisting essentially of a fuel, and ammonium nitrate sensitized with from 0.02 to 1.0 part of hydrazine mono-nitrate to each part of ammonium nitrate.

2. The explosive composition of claim 1 wherein the ammonium nitrate and hydrazine mono-nitrate are fused together.

3. An explosive comprising ammonium nitrate, hydrazine mono-nitrate, trinitrotoluene, aluminum, and filler material, wherein the ammonium nitrate comprises 78 to 83 per cent by weight and the hydrazine mono-nitrate 10 to 5 per cent by weight.

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