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PROVISIONAL SPECIFICATION.

Improvements in Explosives.

We, WILLIAM RINTOUL, Manager of Research Department, ERNEST GEORGE BECKETT, Chemist, and NOBEL'S EXPLOSIVES COMPANY, LIMITED, Manufacturers, all of Ardeer Factory, Stevenston, Ayrshire, do hereby declare the nature of this invention to be as follows:—

5 This invention relates to explosives, and is based on our discovery that the compound dicyandiamidine perchlorate is an explosive, and possesses valuable properties that have not hitherto been known.

The invention consists in preparing dicyandiamidine perchlorate and in employing it as an explosive alone or as an ingredient in a composite explosive.

10 The invention also consists in methods of preparing the dicyandiamidine perchlorate.

The dicyandiamidine perchlorate can be readily prepared from other salts of dicyandiamidine, which in turn are prepared from dicyandiamide by known methods.

15 According to one method of preparation of the perchlorate, the dicyandiamide is converted into dicyandiamidine sulphate, and to the solution of the latter is added a solution of barium, strontium or calcium perchlorate. The insoluble sulphate is filtered off, and the dicyandiamidine perchlorate recovered from the filtrate by evaporation.

20 We have also found that the perchlorate can be economically prepared by converting the dicyandiamide into dicyandiamidine hydrochloride by heating the former with hydrochloric acid, and adding to the solution a hot concentrated solution of sodium perchlorate. The dicyandiamidine perchlorate crystallises out when the solution is cooled. The above reaction also takes place, however, at
25 ordinary temperatures.

The dicyandiamidine perchlorate may be further purified by recrystallising it from solution in water.

Dicyandiamidine perchlorate, which may also be called guanyl-urea perchlorate, is approximately represented by the formula $C_2H_6N_4O.HClO_4$.

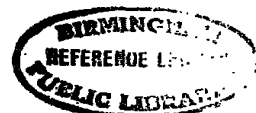
30 We have found it to have the following properties:—

When tested in the Trauzl lead block it shows an explosive power equal to that of trinitrotoluene, and is so insensitive to mechanical shock that a 10 kilo fall-hammer fails to explode it from a height of 2 metres. Notwithstanding its insensitiveness to shock, however, it can be detonated by a No. 3 detonator.

35 When slowly heated it begins to melt with slight decomposition at a temperature of about $200^{\circ}C$. and is completely melted at about $300^{\circ}C$. It explodes at a temperature of $378^{\circ}C$. The salt is soluble in cold water to the extent of about 15% and is less hygroscopic than potassium nitrate. The absolute density of the pure salt is about 1.8.

40 This compound is well suited for use as a blasting agent, either alone or as an ingredient in composite explosives. It is also suitable for use as an explosive

[Price 6d.]



Improvements in Explosives.

for military and naval purposes, and generally for such purposes as call for the employment of a high explosive.

Dated this 18th day of October, 1915.

MARKS & CLERK.

COMPLETE SPECIFICATION.

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Improvements in Explosives.

We, WILLIAM RINTOUL, Manager of Research Department, ERNEST GEORGE BECKETT, Chemist, and NOBEL'S EXPLOSIVES COMPANY, LIMITED, Manufacturers, all of Ardeer Factory, Stevenston, Ayrshire, Scotland, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:— 10

This invention relates to explosives, and is based on our discovery that the compound dicyandiamidine perchlorate is an explosive, and possesses valuable properties that have not hitherto been known. 15

The invention consists in employing dicyandiamidine perchlorate as an explosive alone, or as an ingredient in a composite explosive.

The invention also consists in methods of preparing the dicyandiamidine perchlorate.

The dicyandiamidine perchlorate can be readily prepared from other salts of dicyandiamidine, which in turn are prepared from dicyandiamide by known methods. 20

According to one method of preparation of the perchlorate, the dicyandiamide is converted into dicyandiamidine sulphate, and to the solution of the latter is added a solution of barium, strontium or calcium perchlorate. The insoluble sulphate is filtered off, and the dicyandiamidine perchlorate recovered from the filtrate by evaporation. 25

We have also found that the perchlorate can be economically prepared by converting the dicyandiamide into dicyandiamidine hydrochloride by heating the former with hydrochloric acid, and adding to the solution a hot concentrated solution of sodium perchlorate. The dicyandiamidine perchlorate crystallises out when the solution is cooled. The above reaction also takes place, however, at ordinary temperatures. 30

The dicyandiamidine perchlorate may be further purified by recrystallising it from solution in water. 35

Dicyandiamidine perchlorate, which may also be called guanlyl-urea perchlorate, is approximately represented by the formula $C_2H_6N_4O.HClO_4$.

We have found it to have the following proportions:—

When tested in the trauzl lead block it shews an explosive power equal to that of trinitrotoluene, and is so insensitive to mechanical shock that a 10 kilo fall-hammer fails to explode it from a height of 2 metres. Notwithstanding its insensitiveness to shock, however, it can be detonated by a No. 3 detonator. 40

When slowly heated, it begins to melt at a temperature of about 200° C., and is completely melted at about 300° C. It explodes at a temperature of 378° C. The salt is soluble in cold water to the extent of about 15 per cent., and is less hygroscopic than potassium nitrate. The absolute density of the pure salt is about 1.8. It has no water of crystallisation and is obtained and used as a fine crystalline powder. 45

This compound is well suited for use as a blasting agent, either alone or as an ingredient in composite explosives. It is also suitable for use as an explosive 50

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for military and naval purposes, and generally for such purposes as call for the employment of a high explosive.

As an example of the use of dicyandiamidine perchlorate as the main ingredient in a blasting explosive the following composition is suitable:

5	Dicyandiamidine perchlorate	-	-	-	-	69%
	Sodium nitrate	-	-	-	-	29%
	Woodmeal	-	-	-	-	2%

As an example of the use of dicyandiamidine perchlorate in sensitising more inert materials the following composition is suitable:

10	Ammonium nitrate	-	-	-	-	80%
	Trinitrotoluene	-	-	-	-	10%
	Dicyandiamidine perchlorate	-	-	-	-	10%

As an example of the use of the explosive for military or naval purposes such as the filling of shells or hand grenades, we load it either by itself in the form of a crystalline powder or in admixture with other substances such as ammonium nitrate or trinitrotoluene. We have found that when used alone dicyandiamidine perchlorate gives excellent results in hand grenades.

The following is an example of a suitable shell-filling composition employing the new explosive in admixture with other substances:—

20	Ammonium nitrate	-	-	-	-	80%
	Trinitrotoluene	-	-	-	-	10%
	Dicyandiamidine perchlorate	-	-	-	-	10%

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. The use of dicyandiamidine perchlorate as an explosive or an ingredient in explosive compositions.
2. The methods of preparation of dicyandiamidine perchlorate hereinbefore described.
3. The explosives and explosive compositions hereinbefore described.

Dated this 18th day of May, 1916.

MARKS & CLERK.