Patented Jan. 22, 1929. 1,700,085

# UNITED STATES PATENT OFFICE.

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## EXPLOSIVE.

No Drawing. Application filed November 21, 1925, Serial No. 70,689, and in Great Britain November 29, 1924.

This invention is for improvements in or relating to explosives and has reference to the class comprising an oxygen-carrying base in the form of a compound (such as potassium chlorate) containing readily available oxygen, and in admixture with this, a second component, known as the combustible of the explosive, which forms with the base, an explosive composition.

An object of the invention is to provide an improved moisture-impervious explosive. A further object is to provide an improved grain powder or friable powder explosive of the class defined and method of manufacturing same. A further object still is to provide an improved moisture-impervious plastic explosive of the class referred to and method of manufacturing the same.

The present invention comprises an explosive of the type described the particles or particle-aggregates of which are coated with a synthetic resin, for example a phenol-aldehyde condensation product as a continuous surface phase over the particles. This is insured by employing a preformed synthetic resin which is incorporated as such into the explosive mixture. In the mixing as hereinafter described the particles become coated with the resin which being introduced as a continuous phase, remains as such in coating the particles. This would not be the case if the resin were produced by a reaction taking place in the mixture.

It is found according to the present invention that not only do such resins so applied effectively render the explosive waterproof, but they also act as the required fuel, and in practice they assist in the production of an explosive having a desirable "grain".

In case it is desired to reduce the quantity of synthetic resin to be employed the base substance can be impregnated with a liquid fuel for example fuel oil or paraffin oil. This will be enclosed and retained by the synthetic resin and it is an advantageous property of these resins in this connection that they are not dissolved or softened by ordinary mineral oils; neither is their adhesion to the base thereby interferred with.

In some cases there may be a substantially non-volatile and explosive aromatic nitro-body in the synthetic resin for the purpose of modifying the explosive properties of the composition.

The resin may be liquid or plastic so that the resulting explosive is plastic, if desired. Alternatively the resin coating may be an indurated synthetic resin, in which case the explosive is readily produced in granular form.

The coating ingredient may be the gel of a synthetic resin and a substantially non-volatile and explosive aromatic nitro-body, for example a gel of a phenol-formaldehyde resin and mono-nitro-toluene with or without other nitro-bodies.

The invention includes various methods of manufacture as hereinafter described and claimed.

### *Example I.*

According to this example, which illustrates the invention as applied to the production of a grain powder, 85 parts of potassium chlorate crystals are introduced into an incorporator and are intimately mixed therein with a sufficient quantity of the solid variety of the well-known phenol formaldehyde condensation product resin "A" dissolved in a volatile solvent, such as commercial alcohol, to add 15 parts of the synthetic resin to the base. The agitation of the mixture is of such form as to result in the production, under gentle application of heat (e. g. 70° F.) during the agitation of a mass of hard segregated grains consisting of the chlorate crystals or small agglomerates thereof coated with the synthetic resin.

Instead of producing the grains by a particular kind of agitation in an incorporator as above described, the mixture of chlorate crystals and resin may be rolled or otherwise formed into a cake or sheet and after drying and hardening the cake or sheet by application of heat, (e. g. up to 100° C.) the material may be disintegrated to any desired degree of fineness of grain, or even pulverized into the form of a fine friable powder.

The combustible of the explosive may consist solely of the synthetic resin coating on the chlorate crystals or it may comprise an additional component in the form of a liquid fuel, such as fuel oil or paraffin oil, in which event the liquid fuel may be applied to the

base of the explosive by impregnation either before or after coating with the synthetic resin or by incorporation along with the resin, but preferably after coating with the resin.

The combustible may comprise a component which is an explosive in itself, such as an explosive nitro-body (e. g. a nitro-toluene), and the following is a further example of the invention illustrating the embodiment of this feature as applied to a plastic explosive.

*Example II.*

2.25 parts of crystalline mono-nitro-naphthalene are dissolved in 3 parts of mono-nitro-toluene, if necessary, with the aid of gentle heat. The temperature during this operation may be about 70° F. To the resulting solution, 9.25 parts of crystalline dinitrotoluene are added and with further gentle application of heat, are dissolved in the solution. To the final nitro-body solution, 7 parts of the phenol-formaldehyde resin known as bakelite "formite" resin A in the solid state are added with continued gentle application of heat, and the mixture is stirred until a homogeneous jelly of the nitro-bodies and resin results.

The aforesaid homogeneous mixture of nitro-bodies and resin is incorporated with a mixture of 72.5 parts of potassium chlorate or perchlorate and 6 parts of dried woodmeal. The incorporation is effected in a mechanical incorporator, the mixture of chlorate or perchlorate crystals and the woodmeal having been first placed in the incorporator.

The resulting plastic mixture may be introduced into cartridges in any known manner, for example by extrusion in cartridge form.

If the nitro-body or nitro-bodies be incorporated along with the resin the same may be either admixed with the base separately from the resin or formed into a liquid or plastic mixture with the resin (e. g. a plastic jelly) and incorporated in this state into the base. By this latter means the coating on the crystals is a homogeneous mixture of resin and nitro-bodies.

It is to be noted that in the case of a plastic explosive the synthetic resin alone will not suffice as the combustible and some other body (e. g. a nitro-body) is necessary in conjunction with the resin to impart to the composition the requisite degree of detonatability. On the other hand, it is found in the case of a grain powder that the combustible of the explosive may consist solely of the hard synthetic resin. The example first given is illustrative of this fact.

It is found that the size of grain may be varied by varying the quantity of liquid or liquefied resin incorporated into the base. The proportions in which the synthetic resin may be employed may be varied within wide limits. The following examples illustrate the degree of possible variation in the proportions of resin, oxygen-carrying salts, and other ingredients of the explosive, that may be made.

*Example III.*

| | Parts. |
|---|---|
| Potassium chlorate | 95–70 |
| Synthetic resin | 5–30 |

*Example IV.*

| | Parts. |
|---|---|
| Ammonium perchlorate | 69–57 |
| Synthetic resin | 16–30 |
| Manganese dioxide | 15–13 |

*Example V.*

| | Parts. |
|---|---|
| Ammonium nitrate | 95–70 |
| Synthetic resin | 5–30 |
| Potassium perchlorate | 5–20 |

*Example VI.*

| | Parts. |
|---|---|
| Potassium nitrate | 75–60 |
| Sulphur | 18–10 |
| Manganese dioxide | 5–2 |
| Synthetic resin | 21–6 |

This example is one for the production of a black grain powder. After incorporation the powder is hardened and dried and the grains are glazed in the usual manner (e. g. in a glazing drum) by the aid of a small quantity of graphite.

*Example VII.*

The following is an example of an explosive wherein the synthetic resin employed is a thio-urea resin product:—

| | Parts. |
|---|---|
| Potassium perchlorate | 75 |
| Potassium nitrate | 15 |
| Thio-urea resin syrup containing 2% of water | 7.5 |
| Thio-urea resin syrup containing 40% of water | 2.5 |

As in the case of phenol formaldehyde condensation products, the urea and thio-urea resins may be employed in widely varying proportions.

The urea and thio-urea resins may also be employed either alone or in conjunction with other synthetic resins and with or without incorporation of nitro-bodies.

A small proportion of glycerine or castor-oil may be mixed with any of the resins if desired as a softening agent.

It has been found that a combustible consisting of a mixture of synthetic resin and a substantially non-volatile and explosive aromatic nitro-body or nitro-bodies can be produced which is plastic or liquid at normal temperatures, or, when desired, at very low temperatures, by suitably varying the proportions in which the component parts of

the combustible are employed. The viscosity of the combustible, may also be varied within wide limits, as desired.

When phenol formaldehyde condensation products are employed it is preferred to use the product known as "Product A" which is the product of the first stages of condensation. This product may be either liquid pasty or solid, but in either form it is readily utilizable for the pasty form can be rendered liquid by the addition of a volatile solvent such as commercial alcohol, and the solid variety can be readily dissolved in commercial alcohol and acetone for example, or it may be dissolved in certain liquid or liquefied nitro-bodies.

During the heating of the resin, the resin passes from the initial product A stage to the next stage in the condensation which results in product B, and if heating be continued (although it is not generally necessary to harden beyond the product B stage), through this stage to the final product C stage.

However, the heating may be controlled so as to obtain any intermediate degree of hardness desired.

Generally, for hardening the grain powder, a temperature of about 70° C. is employed and duration of heating is from half an hour to one hour. The temperature may exceed 70° C., however. For example, it may be any temperature between 70°C. and 100°C., in which event the duration of heating will generally be less.

In addition to the substances already mentioned sodium chlorate, perchlorate or nitrate may be used as the body having readily available oxygen.

I claim:—

1. An explosive of the type described the particles or particle-aggregates of which are isolated from each other by a synthetic resin constituting a continuous phase between the particles.

2. An explosive of the type described the particles or particle-aggregates of which are isolated from each other by a phenol aldehyde condensation product constituting a continuous phase between the particles.

3. An explosive of the type described the particles or particle-aggregates of which are coated with a synthetic resin containing a substantially non-volatile and explosive aromatic nitro body for the purpose of modifying the explosive properties of the composition.

4. An explosive of the type described the particles or particle-aggregates of which are coated with a phenol aldehyde condensation product containing a substantially non-volatile and explosive aromatic nitro body for the purpose of modifying the explosive properties of the composition.

5. An explosive of the type described the particles or particle-aggregates of which are coated with a synthetic resin as a continuous surface phase over the particles which resin is sufficiently yielding to render the explosive deformable under manual pressure.

6. An explosive of the type described the particles or particle-aggregates of which are coated with a phenol aldehyde condensation product as a continuous surface phase over the particles which resin is sufficiently yielding to render the explosive deformable under manual pressure.

7. An explosive of the type described the particles or particle-aggregates of which are coated with a synthetic resin containing a substantially non-volatile and explosive aromatic nitro-body for the purpose of modifying the explosive properties of the composition said resin and nitro-body constituting a sufficiently yielding coating to render the explosive deformable under manual pressure.

8. An explosive of the type described the particles or particle-aggregates of which are coated with a synthetic resin containing a substantially non-volatile and explosive aromatic nitro-body for the purpose of modifying the explosive properties of the composition said product and nitro-body constituting a sufficiently yielding coating to render the explosive deformable under manual pressure.

9. An explosive of the type described the particles or particle-aggregates of which are isolated from each other by irreversibly coagulated synthetic resin constituting a continuous phase between the particles.

10. An explosive of the type described the particles or particle-aggregates of which are coated with a gel of a synthetic resin with a substantially non-volatile and explosive aromatic nitro-body.

11. An explosive of the type described the particles or particle-aggregates of which are coated with a gel of a phenol aldehyde condensation product with a substantially non-volatile and explosive aromatic nitro-body.

12. An explosive of the type described the particles or particle-aggregates of which are coated with a gel of a phenol-formaldehyde resin with mononitrotoluene.

13. An explosive of the type described the particles or particle-aggregates of which are coated with a gel of a phenol-formaldehyde resin with mononitrotoluene and other substantially non-volatile explosive aromatic nitro-bodies.

14. In the manufacture of explosives of the kind described, coating the particles or particle-aggregates with a synthetic resin previously prepared as a resin in liquid state.

15. In the manufacture of explosives of the kind described, coating the particles or

particle-aggregates with a synthetic resin previously prepared as a resin in liquid state and thereafter irreversibly coagulating the synthetic resin for the purpose described.

16. A process for the manufacture of explosives which comprises producing a liquid or plastic homogeneous admixture of a synthetic resin previously prepared as a resin in liquid state and a substantially non-volatile and explosive aromatic nitro-body and incorporating therewith a body containing readily available oxygen.

17. A process for the manufacture of explosives which comprises agitating an oxygen-carrying body of the kind described in powdered form with a synthetic resin product previously prepared as a resin in liquid state, the agitation being continued until the mixture assumes a homogeneous granular form in which the liquid is uniformly distributed over the surfaces of the base, and thereafter solidifying the synthetic resin.

18. In the manufacture of explosives of the kind described, coating the particles or particle-aggregates with a pre-formed liquid condensation product of phenol and an aldehyde.

19. A process for the manufacture of explosives which comprises agitating crystals of a crystalline oxygen-carrying body in powdered form with a phenol-aldehyde condensation product in liquid state, the agitation being continued until the mixture assumes a homogeneous granular form in which the liquid is uniformly distributed over the surfaces of the crystalline powder, and thereafter solidifying the phenol aldehyde condensation product.

In testimony whereof I affix my signature.

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