

UNITED STATES PATENT OFFICE.

ROBERTO IMPERIALI, OF BRESCIA, ITALY.

EXPLOSIVE.

1,054,777.

Specification of Letters Patent.

Patented Mar. 4, 1913.

No Drawing.

Application filed May 9, 1912. Serial No. 696,268.

To all whom it may concern:

Be it known that I, ROBERTO IMPERIALI, a subject of the King of Italy, residing at Brescia, in the Kingdom of Italy, have invented new and useful Improvements in Explosives, of which the following is a specification.

When metals such as aluminum or silicon are added to explosives their oxidation during the explosion results in the liberation of an enormous amount of heat which expands the gases resulting from the explosion and materially increases the power of the explosive. The explosives of the present invention contain such oxidizable metals but in novel and highly advantageous combination. The explosives of the present invention contain tungsten intermixed or alloyed with aluminum or with silicon or with both of these metals, together with an oxidizing agent such as ammonium nitrate, and either with or without the further addition of organic nitrated explosives or other explosive materials.

When tungsten is alloyed with aluminum not only is the resulting thermal energy of oxidation in the presence of oxidizing agents increased owing to the heat generated by the tungsten, but also the aluminum is thereby rendered more resistant against the action of oxidizing salts, and it is also more suitable for obtaining in the necessary state of fineness for use in the explosive. Similarly tungsten may be alloyed with both aluminum and silicon and a still more advantageous result obtained, or the tungsten silicid can be used. Again the isolated metals can be used in addition to the alloys, or in intermixture with each other. These mixtures or alloys increase to a marked degree the power of any explosive to which they are added, owing to their great heat of oxidation. They can be added to explosive mixtures, or to nitrated explosives, or they can be used alone with a suitable oxidizing agent such as ammonium nitrate. The metals or their alloys before admixture are reduced to filings, or a fine powder, or a finely divided condition, in which condition they are added to, and intimately intermixed with, the oxidizing agent or other explosive ingredients. The amount of the

metal mixture or alloy which can be used varies within rather wide limits. When added to nitrated explosives even a few parts increase the explosive effect to a marked extent. With nitrate of ammonia alone the use of 65 to 85 parts by weight of the nitrate of ammonium to 35 to 15 parts by weight of the metal mixture or the alloy of the three metals above indicated gives good results. With larger amounts of the alloy an explosive of correspondingly higher power is obtained, and vice versa.

An explosive mixture can be made for example, according to the present invention, by thoroughly drying and grinding to a very fine powder the nitrate of ammonia and intimately intermixing the same with the alloy of aluminum, silicon and tungsten also in a finely divided condition, and stirring the mixture until the powder is substantially homogeneous. The mass is then dried to free it from any traces of moisture absorbed during the process, after which it is filled into cartridges formed, for instance, of paper soaked with paraffin, or packed into airtight metal shells. Such a mixture can be made with varying proportions of the nitrate of ammonia and of the metallic mixture or alloy, and correspondingly higher or lower explosive power obtained. Thus 65 parts of ammonium nitrate can be used with 35 parts of the alloy of the three metals; or up to 85 parts of the nitrate and 15 parts of the alloy. Instead of the alloy of the three metals, tungsten silicid, or an alloy of aluminum and tungsten, *e. g.* Al_4W , can be used, or mixtures of these two alloys, or mixtures of one or both such alloys with aluminum or silicon or both these metals.

Alloys of aluminum with tungsten, or of silicon with tungsten can be used containing these metals in varying proportions. Also the proportions of the three metals in the alloy containing all of them can be varied within rather wide limits. Thus from 5 to 10 parts by weight of tungsten can be used in 100 parts of the alloy, 5 or 10 parts being usually sufficient and more advantageous than a larger amount. Similarly the aluminum and silicon can be varied, *e. g.*, 85 to 40 parts of aluminum, and 10 to 40 parts of silicon, to 5 to 10 or 20 parts of the tung-

sten. Similarly when tungsten metal is used with silicon or with aluminum or with both these metals the proportions can be varied, *e. g.* corresponding to those above indicated; or the metals individually or in mixture can be added to the alloy or a mixture of the alloys.

The explosives of the present invention, such as those above described are of very high power and suitable for the internal charge of grenades, mines, armor piercing projectiles, etc. These explosives have the advantage that they are formed of substances which do not react together and are therefore stable. Exposure to temperatures of from 30° C. to 90° above zero do not occasion alteration. Temperatures up to 450° C. do not occasion deflagration. The mixture of the metals or alloys of the present invention with ammonium nitrate do not burn in contact with fire, nor do they explode when struck with iron upon iron. The action of fulminate of mercury or other suitable detonator is necessary for their explosion.

Instead of using the metal mixture or alloy with ammonium nitrate alone, they can be used with nitro-toluene or other nitrated explosive alone or with addition of ammonium nitrate. In such mixtures, the alloys, or mixtures of them, can similarly be used as indicated above. For example five parts of trinitro-toluene can be added to eighty parts of ammonium nitrate and fifteen parts of the alloy.

I claim:

1. An explosive comprising an alloy of tungsten and an oxidizing agent.
2. An explosive comprising an oxidizing agent and metallic tungsten.
3. An explosive comprising an oxidizing agent and metallic tungsten in the form of a tungsten-aluminum alloy.
4. An explosive comprising an oxidizing agent and metallic tungsten in the form of a tungsten-aluminum-silicon alloy.
5. An explosive comprising an oxidizing agent, tungsten and aluminum.
6. An explosive comprising an oxidizing agent, tungsten, aluminum and silicon.
7. An explosive comprising ammonium nitrate, tungsten and aluminum.
8. An explosive comprising ammonium nitrate, tungsten, aluminum and silicon.
9. An explosive comprising ammonium nitrate and tungsten and aluminum in the form of a tungsten-aluminum alloy.
10. An explosive comprising ammonium nitrate, tungsten, aluminum and silicon in the form of a tungsten-aluminum-silicon alloy.
11. An explosive comprising ammonium nitrate, an alloy of tungsten and an organic explosive substance.

In testimony whereof I affix my signature in presence of two witnesses.

ROBERTO IMPERIALI.

Witnesses:

E. C. DUFF,
W. D. TODD.