UNITED STATES PATENT OFFICE.

CHARLES FRIDRICH HENGST, OF LONDON, ENGLAND.

EXPLOSIVE COMPOUND.

SPECIFICATION forming part of Letters Patent No. 640,160, dated December 26, 1899.

Application filed December 17, 1898. Serial No. 699,626. (No specimens.)

To all whom it may concern:

Be it known that I, CHARLES FRIDRICH HENGST, engineer, a subject of the Queen of Great Britain, residing at No. 20 Burwash road, Plumstead, London, in the county of Kent, England, have invented new and useful Improvements in Explosive Compounds for War and other Purposes, of which the following is a specification.

In carrying my invention into effect I prepare in a suitable receptacle a bath containing two parts sulphuric acid, (H_2SO_4,) specific gravity 1.85 at 18° centigrade, one part of nitric acid, (HNO_3,) from 1.42 to 1.5 specific gravity at 18° centigrade, mixed together and agitated by mechanical means or by manual power. The process of mixing these acids in the manner stated causes the temperature of the resultant liquid to rise, and a certain amount of ebullition takes place. The bath is allowed to stand until such ebullition ceases and the temperature has fallen to the normal condition of the atmosphere. I then prepare esparto fiber by passing the grass through a disintegrator until the mass is separated into a woolly or fluffy consistence, not bleached, since chlorine or the like tends to deteriorate the explosive. The esparto fiber so prepared is then immersed in the bath hereinbefore described when the temperature thereof is normal, a sufficient quantity being added to make a pulp, which is left to macerate from five to twenty-four hours, according to circumstances of usage and the atmospheric temperature externally. When the process of maceration is fully effected, the material so treated is removed from the tank or receptacle and placed in an acid-proof press, so that all the acid liquor capable of being pressed out may be so treated, the residue being washed out of the mass by continuous baths of pure water until litmus or other acid tests are not affected. Heretofore such process has taken from two to four weeks to eliminate the acid; but I prefer to turn the pressed and partly-washed pulp into a bath containing three ounces of potassium bicarbonate ($HKCO_2$) in six gallons of water, (or in this proportion for larger quantities,) and the bath is agitated and the boiling-point is maintained for six or eight hours, the loss by evaporation being made up by the addition of fresh water or old solution. The pulp is then placed in a boiler and boiled from six to ten hours. Potassium carbonate (K_2CO_3) is added in the proportion of 0.5 to 5 during this part of the process. I prefer to carry out the boiling operation by means of steam under pressure, since the water becomes discolored, and a fresh supply has to be provided to compensate loss by evaporation. The material is then removed to another tank or steam-boiler and treated with sufficient hydrochloride of triamidoazobenzene ($H_2N.C_6H_4N_2C_6H_3(NH_2)_2$) to color it dark brown. Then the mass is removed to a hydro-extractor or centrifugal water-separator, with a copper net of fine mesh, water being added during the process until the separated fluid is not colored nor is affected by an acid test, such as litmus or the like. At this point of manufacture the material has become of a highly-explosive nature, and great care must be exercised in drying it. I prefer to carry out the drying process by means of steam-pans subjected to steam-pressure from thirty to forty pounds per square inch, motion being imparted to the mass during the operation to prevent caking. This may be effected by mechanical or manual means. A second quantity of disintegrated pulp may be put in the acid-bath; but as the mixture has deteriorated by the first process the duration of the time of the macerating process has to be increased by one-half. Said bath may also be used a third time, with a slight addition of fresh acid.

After the pulp is dried, as described, I place it in an edge-running mill, previously preparing starch $(C_6H_{10}O_5)n$ mixed with water to form a paste, with no lumps remaining, then boiling to render it of a gummy consistency, after which it is amalgamated with the pulp in the grinding-mill, about five per cent. of commercial charcoal and ten per cent. of pure potassium nitrate (KNO_3) being added at the same time, such quantities being varied according to the conditions of usage of the explosive compound, whether for small arms, ordnance, or blasting. Now for large ordnance, in which a slow-burning powder is required, I prefer at this period of the process to add eight per cent. of one of the normal

paraffins, such as C_8H_{18}, which is of a jelly-like consistency. The whole mixture is then ground in the edge-running mill for three to four hours until it becomes a homogenous mass, after which it is again dried by the steaming apparatus until the liquid portion has evaporated. I may add at this stage a small quantity of barium nitrate, $Ba(NO_3)_2$.

When the mass is thoroughly dry, it is passed through fine sieves or screens to remove all lumps and reduce it to a fine powder, which may then be pressed or molded into any required shape. Then in order to render the granules, blocks, or cubes water and damp proof I utilize some waste material of the compositions hereinbefore described, mixing therewith two parts of acetone or dimethyl ketone $\left(CO\begin{Bmatrix}CH_3\\CH_3\end{Bmatrix}\right)$ and one part of benzoline or phenol, (C_6H_5OH,) mixing these with the waste material until it becomes of a gummy consistence, in which the granules or blocks are dipped or otherwise coated. This renders the explosive compound perfectly water and damp proof.

An alternative method of waterproofing, which is in practice more expensive, consists in placing the pulverized material (before pressing and forming) into an air-tight mixing-machine, adding the acetone and phenol in quantities sufficient to dissolve the powder and render it pasty when it is cut or pressed into the desired shape. It may subsequently be dried by steam, but preferably by a vacuum process, in order to recover the residual products. The granules, blocks, or the like when cut, pressed, or formed resemble glass and are impervious to moisture, and combustion during explosion is at a slow rate, giving a low pressure with a high velocity.

I may mention that in practice the first, second, and third pulps prepared in the acid-bath should be mixed together in the grinding process, so as to produce a uniform compound.

The explosive herein described is not ignited by concussion, standing the hammer and anvil test, is practically smokeless when fired, and is free from nitrous or other fumes, and it does not corrode or otherwise attack the metal of a gun or the like in which it may be used.

What I claim, and desire to secure by Letters Patent of the United States, is—

The process of preparing an explosive compound consisting in the following steps: first, mechanically disintegrating espartograss and thereby giving it while unbleached a woolly or fluffy consistence; secondly, macerating this material for several hours in a bath consisting of a mixture of two parts of sulphuric acid and one part of nitric acid at temperature of the atmosphere and in sufficient quantity to make a pulp; thirdly, expressing the acid liquor and washing out the residue thereof; fourthly, boiling the mass thus freed from acid in an aqueous solution of potassium bicarbonate for six or eight hours; fifthly, coloring the resulting material by the application of hydrochloride of triamidoazobenzene; sixthly, washing and straining the mass until the fluid thus separated is not affected by an acid test; seventhly, drying the said mass; eighthly, grinding it with starch of gummy consistency and a small quantity of charcoal and potassium nitrate, until these materials are thoroughly mixed; ninthly, drying the mixture; tenthly, sifting this material to reduce it to a fine powder; and finally molding it into any desired form and covering the grains with a waterproof coating, substantially as set forth.

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Witnesses:
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