Patented Aug. 14, 1923. 1,464,667

UNITED STATES PATENT OFFICE.

WALTER O. SNELLING, OF ALLENTOWN, PENNSYLVANIA, ASSIGNOR TO TROJAN POWDER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

EXPLOSIVE.

No Drawing. Application filed August 6, 1919. Serial No. 315,674.

To all whom it may concern:

Be it known that I, WALTER O. SNELLING, a citizen of the United States, and resident of Allentown, Lehigh County, Pennsylvania, have invented certain Improvements in Explosives, of which the following is a specification.

My invention relates to explosives for use in coal mining operations, and its object is to provide an explosive possessing the characteristics requisite for safe use in the presence of the inflammable gases prevalent in coal mines, and possessing also the property of stability which is an essential of all practical commercial explosives.

Exhaustive experiments have shown that the flame temperature of explosives must be close to 2000° C. or lower to insure safety when the explosives are employed in the presence of inflammable mine gases. It has been one of the practices in attempting to reduce the normal flame temperatures of explosives to the safety point, to add to the explosive material salts such as sodium sulfate, magnesium sulfate, aluminium sulfate and zinc sulfate, containing large amounts of water of crystallization, the theory of the use of such salts being that a cooling effect is produced upon the flame of explosion through the utilization of a portion of the heat energy in vaporizing the water of crystallization and through the distribution of a further portion of the heat energy through the water vapor thus produced. This method has proved successful to the extent that lower flame temperatures have been obtained, but the product has proved unpractical as a commercial explosive because of an inherent instability. These explosives have been found to be extremely liable to deterioration on storage, and particularly so if they become somewhat wet.

I have discovered that the lack of stability of these explosives is due to the fact that the temperature reducing agents hitherto employed have the property of entering into chemical reaction with the nitrates, such as the nitrates of ammonium, sodium, potassium, and barium, which form a constituent of all commercial coal mining explosives. I have further discovered that this tendency of the temperature reducing agents to enter readily into reaction with the soluble alkali nitrates and alkali earth nitrates which are present in coal mining explosives, is due to the ready solubility in water of the said agents, there being in every explosive a small amount of moisture, of which a few tenths of one per cent is sufficient to start a slight chemical interchange or reaction which rapidly increases.

To overcome this difficulty I propose to employ as my temperature reducing agents certain salts containing relatively high percentages of water of crystallization which salts I have found will not react with the nitrates of sodium, ammonium, potassium and barium, and which accordingly may remain in admixture with an explosive for an indefinite period with no resultant deterioration. These salts are for practical purposes substantially insoluble in water, requiring fifty or more times their own weight of water to bring about solution, and it is due to this property that they are able to withstand admixture with alkali nitrates and alkali earth nitrates, without undergoing reaction.

There are many materials adapted to the purposes of my invention. As already indicated, these materials should contain suitable amounts of water of crystallization or of constitution, and must be relatively insoluble in water: but also they should be relatively chemically inert, since there are many materials possessing the first named properties which are nevertheless unsuitable for incorporation in an explosive because of their strongly acid or basic properties, or for other reasons. As examples of some of the materials which I have found adapted to my purpose, I may mention gypsum and ulexite, and hydrous water insoluble minerals, either natural or artificial, such as Brucite, Colemanite, Gibbsite, and Evansite. I have found also that in general all chemically inert and water insoluble borates, sulfates, carbonates and silicates, if they contain a suitable amount of water of crystallization, may be applied to the purpose of my invention, as well as certain phosphates and arsenates of iron and other metals. I prefer to use the borates of calcium and magnesium such as Colemanite and ulexite, and such minerals as Brucite and gypsum, because of their relative availability; but in general, any material which is relatively chemically inert, which holds 10% or more of water of crystallization, and which re-

quires for its solution not less than fifty times its own weight of water at a temperature of 20° C. is suitable.

In the formation of my explosive, a suitable amount of the temperature reducing agent is mixed with the explosive material, the proportion in which these materials are present depending upon the amount of water of crystallization contained by the temperature reducing material, and upon the extent of the reduction desired. With materials holding large amounts of water of crystallization, the amount of the temperature reducing agent present in the explosive may be roughly 3% to 25%, while with materials holding small amounts of water of crystallization the amount of the reducing material present may be 10% to 40%. As specific examples, I may form my explosive of 80% explosive base and 20% ulexite; or if gypsum is employed I may have 30% of this material with 70% of explosive base. In any event, enough of the cooling agent should be added to insure the presence in the explosive of 3% to 20% of available water, and for coal mining purposes sufficient material should be added to bring the flame temperature of the explosive below 2200° C. and preferably below 2000° C.

Where in the claims I employ the terms materials or salts containing water, I refer to water contained or held in such a form as to be available for the purpose described, such as water of crystallization, or water of constitution.

1. An explosive mixture comprising a nitrate explosive base associated with a water-containing water-insoluble borate.

2. An explosive mixture comprising a nitrate explosive base associated with a hydrous calcium borate.

3. An explosive mixture comprising a nitrate explosive base associated with ulexite, said ulexite constituting 3% to 25% of the mixture.

WALTER O. SNELLING.