

UNITED STATES PATENT OFFICE

1,960,907

EXPLOSIVE

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6 Claims. (Cl. 52—1)

This invention relates to explosives and more particularly to liquid oxygen explosives.

In the use of liquid oxygen explosives a suitable quantity of carbon or carbonaceous material is placed in a bag or wrapper or made into a cartridge, and liquid oxygen is added thereto. The cartridges actually used in this manner may be of considerable size and when they are to be used they are placed or dropped in a hole or bore to be exploded, the detonating material arranged thereon and the charge then tamped. The cartridge is fired by detonation of the detonating material. It has been found that granular carbons having a high degree of absorption for liquid oxygen or other explosives are best suited from the standpoint of safety for use in manufacturing such cartridges. A granular carbon of the type commercially known as Bugbird carbon made in accordance with the Bugbird Patents Nos. 1,706,871, 1,779,530 and 1,781,214 may be used.

This material is obtained by carbonizing liquors rich in dissolved lignins, such as those derived from the manufacture of wood pulp by the alkali (soda) process. The carbonized lignin residues are leached to remove water soluble impurities and then submitted to a slight grinding operation to reduce the grains to a more or less uniform size. This produces a granular carbon in which the largest grains are not more than about $\frac{1}{4}$ " in their longest dimension and so that not more than about 25 percent of the material will pass through a 100 mesh screen.

One objection to liquid oxygen explosives has been that they are too sensitive and as a result, premature explosions have been caused by stones or other objects falling on the saturated cartridges as they are being lowered into drill holes or by shocks accidentally transmitted to the saturated cartridges or any other manner. In the prior patent to George St. John Perrott and me, No. 1,860,816, granted May 31, 1932, we have disclosed and claimed one method of regulating the sensitivity of explosives of this type wherein an incombustible material in a finer state of division than the carbon is added to the carbon.

I have found that the sensitivity of explosives of this type can be regulated so that the proper degree of sensitivity may be obtained by adding to the carbon an amount of moisture greater than its normal moisture content and that the sensitivity can be regulated in this manner without detracting from the other valuable properties of the explosive. The normal moisture content of granular carbons of the Bugbird type that

are useful in the manufacture of liquid oxygen explosives will vary according to climatic conditions but will generally average from 5 to 8%. By increasing the moisture content beyond this point a decrease in sensitivity may be obtained to an extent that the explosive is comparatively safe to handle. Nevertheless, it retains its effectiveness, its shattering or disruptive properties and its propulsive strength are not materially impaired. While the moisture content may be varied within rather wide limits, I have found that the best results are obtained with carbons of the type referred to above when the moisture content is between 15 and 25%. A greater or less amount of moisture may be employed. With special types of granular carbons I have found that up to 32% of moisture may be employed without materially impairing the other desirable properties of the explosives. When an amount below 15% is employed, the decrease in sensitivity is less marked.

The moisture may be added to the carbon in any desired way. Carbon of this character possesses a great affinity for moisture and to condition small quantities the carbon may merely be exposed to a moist atmosphere for a sufficient length of time to permit it to take up the desired amount of moisture. In the experimental work leading up to this invention the carbon has been stored prior to the time when the liquid oxygen is added to it in a humidifying room wherein the moisture content is regulated and wherein a moist atmosphere is maintained. By storing the carbon in this manner it will take up any desired amount of moisture. For actual manufacture of the cartridges, spraying, mixing or other methods will be apparent to those skilled in the art. When the explosive is to be used and the moisture content of the carbon has been adjusted to the desired percent, the liquid oxygen or other explosive may be added to it in the usual manner by submerging the cartridge in liquid oxygen or other suitable volatile oxidizing agent until a sufficient quantity thereof has been absorbed by the carbon. Any other desired method of adding the liquid oxygen or other explosive liquid to the carbon may be employed. The saturated cartridge so prepared is subsequently fired by any known means, such as a fuse, an electric spark, a detonator or primer in the usual manner.

The effect of the added moisture to liquid oxygen explosives may best be illustrated by the results of impact tests. In this test a short section of a cartridge of the explosive to be tested is placed on an anvil and a known weight is

dropped from a given height striking the sample. The sensitivity of the explosive is determined by the distance that a known weight must fall to explode the material. With commercial types of carbon now employed in explosives of this type and which usually contain from 5 to 8% of moisture, impact tests were made in which the carbon was bone dry and similar tests were made with varying known quantities of moisture. Thus, with carbon containing no moisture, explosions occurred when a weight of 101.9 kilograms was dropped 2.5 centimeters. When the moisture content is increased to 4.2%, a drop of 5 centimeters is required to explode the charge. Similarly with a moisture content of 8.5% a drop of 10 centimeters is required. By further increasing the moisture content in varying amounts up to 18.8% this distance can be increased to 30 to 40 centimeters without impairing the other characteristics of the explosive.

Likewise, in sensitivity tests by air gap method I have found that an increase in moisture content lowers the sensitivity. In this test a cartridge is cut in half and the two ends placed in a tube a known distance apart. A detonator is placed in one of the half cartridges and the test is conducted to determine the maximum distance at which the explosion of this half of the cartridge will cause the other half to explode. The shorter this distance the greater the sensitivity. When the moisture content of the carbon is increased, as above described, I have found that the distance between the two halves of the cartridge must be decreased in order to obtain an explosion by the air gap method.

In the claims the expression "greater than

normal moisture content" is intended to mean the addition of moisture to a carbon of this type greater than the amount of moisture which it would contain at the time of completion of manufacture.

I claim:

1. A liquid oxygen explosive comprising carbonized lignin residues having a moisture content greater than 8 percent and not more than 32 percent.

2. A liquid oxygen explosive comprising carbonized lignin residues having a moisture content between 15 percent and 25 percent.

3. A liquid oxygen explosive comprising carbonized lignin residues having a moisture content greater than 15 percent.

4. A liquid oxygen explosive comprising granular carbon the granules being of such size that the longest dimension is approximately $\frac{1}{4}$ " and that substantially 25 percent will pass through a 100 mesh screen, said carbon having a high affinity for moisture and having a moisture content greater than 8 percent and not more than 32 percent.

5. The method of making a liquid oxygen explosive which comprises adding moisture to granular carbon in amounts up to 32 percent of the weight of said carbon, and adding liquid oxygen thereto.

6. The method of making a liquid oxygen explosive which comprises adding moisture to granular carbon to increase the moisture content thereof above 15 percent, and adding liquid oxygen thereto.

GEORGE BURKLE HOLDERER.