UNITED STATES PATENT OFFICE.

HERMAN E. STÜRCKE, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE ALBA CHEMICAL COMPANY, OF SAME PLACE.

EXPLOSIVE.

SPECIFICATION forming part of Letters Patent No. 648,222, dated April 24, 1900.

Application filed January 5, 1900. Serial No. 434. (No specimens.)

To all whom it may concern:

Be it known that I, HERMAN EDWARD STÜRCKE, a citizen of the United States, residing in New York, in the borough of Brooklyn, State of New York, have invented a certain new and useful Improvement in Explosives, of which the following is a description.

My invention relates to improvements in explosives characterized by the employment of nitrate of ammonium in novel proportions, whereby the cost of manufacture may be reduced and the explosive character of the compound increased.

Nitrate of ammonium has been employed in the manufacture of explosives prior to my invention, but always in such large proportions as not to secure the best results either as to the effectiveness of the compound or as to its cost of manufacture. I have discovered that when the proportion of nitrate of ammonium is kept within certain limits the relative effectiveness of the compound is increased, while its cost of manufacture is reduced to a minimum. My improved explosive can be produced of numerous well-known ingredients heretofore employed in this art, which ingredients may vary widely in their proportions; but the improved explosive is always characterized by the employment of nitrate of ammonium within prescribed limits.

My improved explosive consists, essentially, of nitrate of ammonium, an organic explosive nitro compound—such as nitroglycerin, nitrocellulose, nitronaphthaline, nitrobenzine, picric acid, &c.—a suitable oxidizing material—such as nitrate of sodium, nitrate of potassium, nitrate of barium, chlorate of potassium, permanganate of potassium, chromic-acid compounds, &c.—a suitable dope which preferably combines with oxygen to produce evolved gases (carbonic-acid gas, steam, sulphurous acid, &c.) with liberation of heat—such as wood fiber, other forms of cellulose-like flour, starch and sugar, resin, sulphur, charcoal, or carbon in various forms—and, if desired, a non-absorbent combustible material—such as tar, pitch, paraffin, vaseline, oils, or fats. The preferred nitro compound used in my improved explosive is nitroglycerin, the preferred oxidizing material is nitrate of sodium, and the preferred dope is wood fiber. Other materials may be added as ingredients in the improved explosive—as, for example, sodium carbonate. Calcium or magnesium carbonate may be added for the purpose of neutralizing the nitro bodies, or ammonium oxalate or carbonate may be introduced for the production of indifferent gases, as is well understood in the art.

Although, as I have stated, the explosive and oxidizing character of nitrate of ammonium has been recognized and such material has been frequently utilized in explosive mixtures, yet the proportions in which I employ nitrate of ammonium with the other ingredients differ materially from the proportions heretofore used. To illustrate these proportions, I will give a few typical examples of my new explosive compositions, the parts in each instance being stated in weight:

Sample.	A.	B.	C.	D.	E.	F.	G.	H.
Nitroglycerin	40	30	20	15	40	30	20	15
Wood fiber	16	18	21	22	12	10	10	10
Sodium nitrate	37	43	49	52	38	46	54	59
Ammonium nitrate	7	9	10	11	8	10	11	10
Vaseline					2	4	5	5
Sulphur								1

In each of the examples of my improved explosive above given the nitroglycerin is combined with at least sufficient wood fiber, and in some instances with more than sufficient wood fiber, to firmly absorb and retain it, as in the manufacture of ordinary dynamite. Instead of using more wood fiber than is required to firmly retain the nitroglycerin the proportion of wood fiber may be reduced until only so much is employed as will act as an effective dope, and some other combustible or oxygen-consuming matter—such as vaseline, oil, fat, resin, carbon, sulphur, &c.—may be added to consume the available oxygen not consumed by the wood fiber. By the expression "available oxygen" I mean that portion of the oxygen contained in the oxidizing agent or agents which after the explosion of the compound is not combined with constituents originally contained in the oxidizing agent or agents. Thus one molecule

of nitrate of sodium will furnish two and one-half atoms of available oxygen, the reaction being thus expressed:

$$4NaNO_3 = 2Na_2O + 2N_2 + 5O_2.$$

On the other hand, one molecule of nitrate of ammonium will furnish in exploding only one atom of available oxygen, the reaction being thus expressed:

$$NH_4NO_3 = N_2 + 2H_2O + O.$$

My improved explosive in every instance is characterized by the intermixture of oxidizing materials in proper proportions to generate sufficient available oxygen to completely oxidize all carbon and hydrogen present to carbonic acid and water and eventually to oxidize the sulphur when present to sulphurous acid, and the characteristic part of my composition is that from five to twenty per cent. of the total available oxygen necessary for this purpose is furnished by the decomposition of the nitrate of ammonium, the remainder of the available oxygen (eighty to ninety-five per cent.) being furnished in the form of the oxidizing material, such as sodium nitrate, which is preferable, or potassium nitrate, barium nitrate, potassium chlorate, &c.

All the explosive compounds made heretofore utilizing nitrate of ammonium contain a very much larger proportion of this producer of available oxygen than I have indicated. The larger proportion of the ammonium powders, ammonium dynamite, "safety-powders," &c., heretofore suggested contain nitrate of ammonium, if at all, in sufficient proportion to generate from forty to one hundred per cent. of the available oxygen, and in no instance prior to my invention has this proportion been reduced to result in the generation of less than twenty-five per cent. of the available oxygen. I have found some very great advantages in the use of nitrate of ammonium within the limits prescribed for my compositions—*i. e.*, in such proportions as to supply only from five to twenty per cent. of the available oxygen. Actual tests have demonstrated that the most efficient proportions are those in which from six to twelve per cent. of the available oxygen is furnished by nitrate of ammonium, the remainder of the available oxygen being furnished by the other oxidizing materials, preferably sodium nitrate. The theoretical explanation is found in the fact that the decomposition of the ammonium nitrate furnishes a maximum amount of gases, while the decomposition of sodium nitrate furnishes a maximum amount of oxygen, and in the consumption of the latter by combustion the sodium nitrate furnishes a maximum amount of heat or energy. A decrease in the relative amount of ammonium nitrate below that necessary to evolve, say, six per cent. of the available oxygen decreases the efficiency and cost of the resulting explosive. An increase in the relative amount of ammonium nitrate above, say, twelve per cent. of the available oxygen not only decreases the efficiency, but increases the cost of the explosive. The amount of ammonium nitrate used may be slightly varied on either side from the proportions stated (six to twelve per cent. of the available oxygen) to secure the highest efficiency, according to the quantity of available oxygen furnished by the nitroglycerin or other explosive substances. According to the purpose to be served I can obtain by a proper selection of the composition a very quick or a slow powder, the former being of greater projective force and the latter of greater recoil. Thus by increasing the proportion of nitroglycerin or by decreasing the proportion thereof the resulting explosive will be relatively quick or slow, as the case may require.

My improved explosive made up in the proportions stated costs from fifteen to thirty-five per cent. less than explosives of equal force now on the market. The large volume of steam and nitrogen created by the detonation of my composition, the complete combustion, and the reduction of temperature, heat being absorbed by the disassociation of the nitrate of ammonium, all combine to make my explosive particularly suitable as a safe powder in "fiery" mines. My improved explosive may contain much less nitroglycerin than powders of equal force now in use, and it is therefore safer to handle and to manufacture. The finer division of the nitroglycerin, or, in other words, its distribution over a larger amount of vehicle, renders my composition less sensitive to low temperatures and less liable to freeze.

Any well-known process may be utilized for the manufacture of the improved explosive, such as would suggest itself to those skilled in the art. A preferable plan of procedure, however, is to first mix the nitroglycerin or other explosive nitro substance with the absorbent or dope and to mix separately therefrom the oxygen-producers (nitrate of ammonium and nitrate of soda or the proper substitutes for the latter) in finely-ground condition with the combustible non-absorbent, if used, (vaseline, oil, fat, tar, &c.,) and finally to mix the nitroglycerin absorbent mixture with a nitrate paste. Finally a small percentage of carbonate of soda, lime, or magnesia may be added to counteract any acidity of the nitroglycerin.

If desired, a gelatine dynamite may be produced by employing a sufficient amount of guncotton with the nitroglycerin and by adding thereto a mixture of vaseline or other non-absorbent combustible matter and an oxygen-producer containing nitrate of ammonium in sufficient quantity as to result in the generation of from five to twenty per cent. of the available oxygen.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. An explosive consisting of an explosive, organic nitro compound, an oxygen-consuming material, ammonium nitrate, and an additional oxidizing material, the oxidizing materials being combined in the proportions by weight, substantially as set forth, whereby the ammonium nitrate will furnish from five to twenty per cent. of the available oxygen, substantially as described.

2. An explosive consisting of an explosive, organic nitro compound, an oxygen-consuming absorbent material, ammonium nitrate, and an additional oxidizing material, the oxidizing materials being combined in the proportions by weight substantially as set forth, whereby the ammonium nitrate will furnish from five to twenty per cent. of the available oxygen, substantially as described.

3. An improved dynamite consisting of nitroglycerin, an oxygen-consuming absorbent material, ammonium nitrate, and an additional oxidizing material, the oxidizing materials being combined in the proportions by weight substantially as set forth, whereby the ammonium nitrate will furnish from five to twenty per cent. of the available oxygen, substantially as described.

4. An improved dynamite consisting of nitroglycerin, an oxygen-consuming absorbent material, ammonium nitrate, and sodium nitrate, said nitrates being combined in the proportions by weight substantially as set forth, whereby the ammonium nitrate will furnish from five to twenty per cent. of the available oxygen, substantially as described.

5. An improved dynamite consisting of nitroglycerin, wood fiber, ammonium nitrate and sodium nitrate, said nitrates being combined in the proportions by weight, substantially as set forth, whereby the ammonium nitrate will furnish from five to twenty per cent. of the available oxygen, substantially as set forth.

6. An improved dynamite consisting of nitroglycerin, wood fiber, vaseline, ammonium nitrate and sodium nitrate, said nitrates being combined in the proportions by weight, substantially as set forth whereby the ammonium nitrate will furnish from five to twenty per cent. of the available oxygen, substantially as set forth.

This specification signed and witnessed this 3d day of January, 1900.

HERMAN E. STÜRCKE.

Witnesses:
JNO. R. TAYLOR,
FRANK L. DYER.