

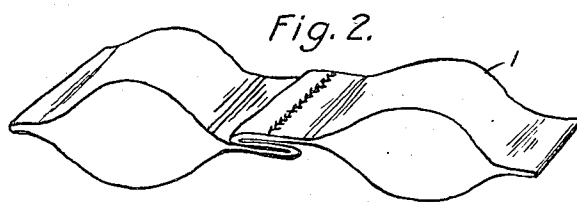
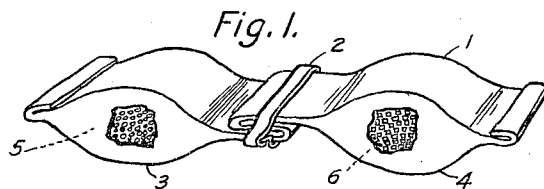
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EXPLOSIVE

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EXPLOSIVE

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This invention is based on my observation that the combustion of organic matter in the presence of a salt of an oxygen acid of halogen is very greatly accelerated by certain other substances.

5 This application relates in part to the use of such accelerators in the compounding of explosives.

For the sake of brevity and clearness in disclosing this invention, the description throughout employs potassium chlorate as a typical illustration of a salt of an oxygen acid of a halogen, and dextrine as a typical example of organic combustible matter, particularly carbohydrates; but these are merely examples of many substances or combinations of substances suitable under the above general terms. For instance, other chlorates, bromates, perchlorates and the like may be used instead of potassium chlorate, or in addition thereto, and starch, rosin, sucrose, wood flour, nitronaphthalene and the like instead of dextrine, or in addition thereto.

Reference is made to the accompanying drawing illustrative, but not restrictive, of the principles of this invention as embodied in an explosive article. Figs. 1-2 depict unitary structures comprising powdered combustible and powdered chlorate maintained separately, though admixed with accelerator as disclosed herein, yet adapted by a simple operation to permit forming the explosive mixture.

There have been proposed numerous accelerators for the reaction between potassium chlorate and combustible matter. It will assist in distinguishing this invention to classify these prior accelerators in two groups. One includes such as manganese dioxide, powdered glass, alumina, etc.; these as accelerators depend on their ability to facilitate the escape of oxygen from potassium chlorate. To the other group of accelerators belong substances commonly called sensitizers. These are composed of easily ignitable substances, such as sulfur, antimony sulfide, cyanogen compounds and the like. Acids or substances which through hydrolysis may yield acidic conditions sufficient to render the halogen oxy-salt unstable under conditions of use likewise are classified with this group of sensitizers.

It is to yet a third class of accelerators that this application pertains. Its members will readily be distinguished from either of the other two groups by properties to be described.

The accelerators of this third class function as such without materially increasing the sensitiveness of an explosive to detonation by shock

or friction. They are either not ignitable at all, or at most are ignitable only with difficulty. They differ from manganese dioxide and those accelerators that facilitate the release of oxygen from potassium chlorate by increased accelerating effect without noticeable increase of sensitiveness of the mixture over where no accelerator is used.

There is a further broad distinction in that when an accelerator belonging to this third class is mixed with potassium chlorate and the mixture heated, there is evolved a gas mixture such that when it is filtered through a plug of fibrous cotton and subsequently bubbled through a solution of silver nitrate it will cause a precipitate of silver chloride to appear. This gas is not necessarily a pure halogen alone. On the other hand, a substance belonging to the manganese dioxide class of accelerators heated in admixture with potassium chlorate does not evolve a gas containing any constituent capable of forming silver chloride when filtered as above and bubbled through a silver nitrate solution.

As examples of substances of this third group of accelerators, without implying limitations by these examples, may be mentioned chromium sesquioxide (Cr_2O_3), chromite ore, chromic chloride, chromic fluoride, ferrous oxalate, ferrous phosphate, ferrous oxide, ferrous carbonate, metallic iron, vanadium oxide. The brown vanadium oxide is satisfactory. It is observed that the atomic weights of vanadium and chromium lie between 50 and 53. This invention comprehends accelerators containing an element whose atomic weight is between 50 and 53, and comprehends accelerators containing material from a group consisting of vanadium, chromium, iron and non-acid compounds thereof.

Although the higher valence compounds of iron and of chromium as such do not react when heated with potassium chlorate to evolve a gas capable of precipitating silver chloride as described, the combustible constituent of the explosive mixtures described herein will, at the moment of explosion, convert these more highly oxidized forms into their respective reduced and active forms. This does not occur however with manganese dioxide and its equivalents. For the sake of brevity the preferred class of accelerators is illustrated by chromium sesquioxide, but without at all implying limitations thereby.

In addition to the accelerating effect which substances belonging to this preferred class have upon the explosive reaction between a salt of an oxygen acid of halogen and a combustible, they

insure a completeness of reaction. Hence there is merit in having present in an explosive mixture a small quantity of one of these accelerators even when a minimum speed of explosion is desired. This will permit slowing the speed of explosion by the introduction of combustibles whose natural rate of burning is less or by the use of the less active oxidizing agents in lieu of some portion of potassium chlorate while maintaining the heat capacity of the composition at a minimum. Similarly it is clear that the speed of explosion may be increased by selection of appropriate combustibles and oxidizing agents while yet insuring completeness of combustion in employing a member of this preferred group of accelerators. Hence the specific properties as well as the general are under greater flexibility of control, referring to other properties as well as to speed.

The degree of subdivision will materially affect the efficiency of results, given an accelerator otherwise suitable in nature. Without being limited to theory, it is desirable that the accelerator be so finely divided that it becomes adsorbed on the other constituents of the explosive mixture. A fineness of ten microns or less serves admirably, but good results are approached if the particles of accelerator average even up to five hundred microns or more. Relative sizes between accelerator and the other solids will vary and should be considered. The constituents of the combustible and of the oxidizing materials may also be finely divided, and normally are, but their fineness of subdivision is less important than that of the accelerator.

In addition to the chemical effect of fineness of division of the accelerator, there is also the important result that dry mixing is employed and becomes the preferred mode of mixing. For example, commercially dry powdered potassium chlorate and commercially dry powdered dextrine, which two may be pulverulent to granular, and chromium sesquioxide of a fineness found commercially in the pigment trade yield admirably to dry mixing. Indeed the use of solvents or the milling together of the members of the explosive preferably is to be avoided, and this avoidance in many instances will serve as one distinguishing characteristic over the prior art.

Any process that will give a reasonably thorough dry mixing may be employed. Preferably a portion of the accelerator is mixed with the oxidizing agent and the remainder with the combustible and then final mixing of these two powder mixtures is accomplished in any manner that would avoid excessive temperature rise, such as would result from shock or undue friction. For example the powders may be rolled or shaken together in a bag. If shipping regulations or other considerations control, the finely divided accelerator may all be mixed with the combustible and none with the oxidizing agent, and the final mixing accomplished subsequently. But the accelerator may be mixed in its entirety with either the potassium chlorate or with the dextrine as desired, and by virtue of the chemical inertness at ordinary temperatures of the accelerator, this preliminary mixing may be facilitated by the use of a mill or its equivalent. Where the term "ordinary temperatures" is employed here or in the claims, it is defined in a general way to mean approximately below the boiling point of water.

By dry powder, reference is made to the phys-

ical state rather than strictly to its chemical condition. It is even desirable that the constituents be not dry to a strict chemical degree, because of the effect that minimum quantities of moisture have in reducing the accumulation of static electricity or other frictional effects. It therefore should be clear that such minimum quantities of water or analogous liquid may be present when the constituents are being mixed without departing from the spirit of this invention. Where in the claims the terms "dry" or "dry mixed" are found, the meaning intended is that water, solvent liquids, oils, alcohol, molten sulfur, etc. are neither added nor caused to be present in the mixture nor with the components to create a different mechanical condition of non-coherence from that of this invention.

The thought is that despite any ostensible compacting the constituents yet are substantially friable or pulverulent.

When a considerable time interval is likely to occur between the preliminary steps of preparation and the final mixing, preferably the finely divided accelerator is mixed in part with the oxidizing agent and in part with the combustible in order to prevent caking.

When it is desired to postpone the final mixing process at all, the oxidizing agent and the combustible, either or both admixed with accelerator, may be stored in separate compartments of a bag. The partition may be such as to be removed easily at will, for example suitable chain stitching. Or by folding or clamping a proper package a similarly available product is obtained containing the potential explosive. The container may be waterproofed or otherwise made resistive chemically and/or physically as desired. The container and its contents after mixing may as a whole be placed in position for firing.

Referring more particularly to the drawing, Fig. 1 depicts a unitary article illustrative of this invention in which individually inert portions of powdered combustible and powdered chlorate or the like are kept separate within the structure, but one or both containing the powdered accelerator, yet in condition for ready intermingling. A container 1 comprises flexible neck portion 2 intermediate bag-like end sections 3 and 4. These sections respectively contain powdered combustible 5 separate from powdered chlorate 6. Either or both contain the powdered accelerator of the non-acidic chromium type, which serves not only as accelerator of explosion after firing but while the portions are separate serves to maintain the combustible and the chlorate in fluent condition for ready intermingling with minimum friction. The neck 2 is shown folded and clamped tightly as a carrier between the separate powders. The clamp is adapted to be removed readily for use of the article as an explosive.

Fig. 2 is similar to Fig. 1, but is illustrative of the variety of means adaptable by a simple operation to permit ready preparation of the chlorate and combustible explosive containing the present type of accelerator. In bag 1 the chlorate and the combustible are separated by stitching across the folded intermediate neck. Chain stitching is secure but is readily removable without undue friction.

The material of these containers will be selected according to the knowledge of those skilled in the art, to resist contamination or deteric-

ration of the powders, and to resist action of the chlorate or the like. Such selection will vary largely with conditions.

Such illustrative embodiments are not intended to be restrictive, as other forms of this invention also are useful. For example the chlorate and the combustible need not necessarily be maintained separate in distinct groups, but individual particles likewise may be kept separate until in combination with the accelerator they are intermingled for explosion.

It is understood that different conditions will be met in practice, but the above descriptions are believed to be sufficiently explicit to enable one to practice this invention. Accordingly the specific example is presented without implying any limitations thereby.

For example two parts by weight of technically powdered potassium chlorate are employed with one part by weight of technically powdered dextrine, and a quantity of chromium sesquioxide of a grade usually furnished to the color trade. Of this last a weight as little as 0.1% or less of the total weight of the mixture will give an appreciable accelerating effect. Preferably about 2% is taken, since the range between 0.5% and 5% has given a maximum effect consistent with economy. There may be an excess over this but an excess may even reduce the accelerating effect. In many instances this avoiding of an appreciably larger quantity that this may be one distinguishing characteristic of this invention from the prior art. The range of other accelerators would follow practically the same percentages as taken in this example.

Having thus disclosed this invention in accordance with the patent statutes, it is intended that these illustrative examples and the appended claims be construed with such limitations only as may be imposed by the prior art.

Accordingly what is claimed is:

1. An explosive that consists of non-acidic constituents comprising combustible and a salt of an oxygen acid of halogen as distinct powders and an accelerator that when mixed and subsequently heated with potassium chlorate directly will cause a gas mixture to be evolved that contains a gaseous constituent capable of precipitating silver chloride when brought into contact with an aqueous solution of silver nitrate, which mixture is stable at ordinary temperatures.

2. An explosive consisting of non-acidic constituents comprising powdered combustible in admixture with powdered salt of an oxygen acid of halogen, which mixture is stable at ordinary temperatures, and a non-acid accelerator, which is stable in this explosive at ordinary temperatures, which accelerator if mixed and subsequently heated with potassium chlorate directly will cause a gas mixture to be evolved that contains a gaseous constituent capable of precipitating silver chloride when brought into contact with an aqueous solution of silver nitrate.

3. An explosive as defined in claim 1, the entire explosive being substantially free from oil.

4. An explosive consisting of non-acidic constituents comprising powdered combustible and powdered salt of an oxygen acid of chlorine and powdered accelerator causing the release of halogen at the moment of explosion, which explosive is stable at ordinary temperatures.

5. An explosive consisting of non-acidic constituents comprising powdered combustible and powdered salt of an oxygen acid of halogen and

accelerator in discrete form which is of such a nature as will cause halogen in some form to be liberated from the salt of the oxygen acid of halogen constituent on explosion, which explosive is stable at ordinary temperatures.

6. An explosive consisting of non-acidic constituents comprising in powdered condition combustible, a salt of an oxygen acid of chlorine and accelerator containing an element whose atomic weight is between 50 and 53, which explosive is stable at ordinary temperatures.

7. An explosive consisting of non-acidic constituents comprising powdered combustible and powdered salt of an oxygen acid of chlorine and adsorbed on one of them an accelerator containing material from a group consisting of vanadium, chromium, iron and non-acid compounds thereof, which explosive is stable at ordinary temperatures.

8. A process for the manufacture of explosives stable at ordinary temperatures wherein finely divided, non-acidic constituents comprising a dry accelerator from a group consisting of vanadium, chromium, iron and non-acid compounds thereof, and dry combustible are mixed together, and subsequently both are mixed with a non-acidic constituent comprising powdered salt of an oxygen acid of halogen.

9. In a process of forming an explosive mixture the steps comprising thoroughly intermixing non-acidic constituents comprising a salt of an oxygen acid of halogen, combustible, and finely divided non-acid accelerator selected from a group consisting of chromium, iron and vanadium and their non-acid compounds, at least one of the first two constituents being maintained finely divided and free from agglutinant, which explosive is stable at ordinary temperatures.

10. An explosive consisting of non-acidic constituents comprising discrete particles each of a salt of an oxygen acid of chlorine and of combustible matter, and non-acid accelerator selected from a group consisting of chromium, iron and vanadium and their non-acid compounds, averaging less than 50 microns in diameter, which explosive is stable at ordinary temperatures.

11. An explosive as defined in claim 10 in which the combustible matter is dextrine.

12. An explosive consisting of non-acidic constituents comprising a salt of an oxygen acid of halogen, carbohydrate and non-acid accelerator selected from a group consisting of chromium, iron and vanadium and their non-acid compounds, in which each ingredient is in dry, powdered, uncoated condition, and the accelerator is a non-acidic, non-combustible substance free from the sulfur type of component, which explosive is stable at ordinary temperatures.

13. An explosive consisting of non-acidic constituents comprising a salt of an oxygen acid of halogen, carbohydrate and chromium oxide, each individually being pulverulent, which explosive is stable at ordinary temperatures.

14. An explosive consisting of non-acidic constituents comprising a salt of an oxygen acid of halogen, combustible and less than five percent of accelerator from a group consisting of vanadium, chromium, iron and non-acid compounds thereof, which explosive is stable at ordinary temperatures.

15. An explosive product comprising a receptacle divided into compartments, one of which contains a dry, solid, pulverulent to granular

- combustible and another of which contains a salt of an oxygen acid of halogen in dry, solid, pulverulent to granular condition, at least one of said materials containing intimately admixed therewith an accelerator as defined in claim 1, all materials therein being non-acidic, said compartments being adapted to be made readily into one, which explosive is stable at ordinary temperatures.
16. An explosive consisting of non-acidic constituents comprising a salt of an oxygen acid of halogen, dextrine and chromium oxide, each individually being pulverulent, which explosive is stable at ordinary temperatures.
17. An explosive consisting of non-acid constituents comprising chlorine oxy-salt, carbohydrate, and essentially chromium sesqui-oxide, each individually being pulverulent, which explosive is stable at ordinary temperatures.
18. An explosive consisting of non-acid constituents comprising carbohydrate in pulverulent condition and discrete particles of material capable of releasing nascent chlorine in contact therewith on heating somewhat above ordinary temperatures.
19. A potentially explosive article of manufacture consisting of non-acid constituents comprising carbohydrate in friable condition and discrete particles of material capable of releasing nascent chlorine in contact therewith on heating somewhat above ordinary temperatures, the article being assembled in unitary form.
20. A safety explosive of unitary structure comprising a confined mass of dry, solid, pulverulent to granular combustible, and isolated therefrom a confined mass of salt of oxygen acid of halogen in dry, solid, pulverulent to granular condition, at least one of said masses containing intimately admixed therewith an accelerator which when mixed and subsequently heated with potassium chlorate directly will cause a gas mixture to be evolved that contains a gaseous constituent capable of precipitating silver chloride when brought into contact with an aqueous solution of silver nitrate, said confined masses individually being inert and being disposed for ready intermingling with each other to form an intimate mixture of explosive nature.
21. A composition comprising carbohydrate in pulverulent to powdery condition containing intimately admixed therewith a minor proportion up to the order of fifteen percent of powder selected from a group consisting of vanadium, chromium, iron and non-acid compounds thereof, said powder being non-acid and adapted to maintain a powdery, fluent condition in the carbohydrate.
22. A composition comprising salt of oxy-acid of halogen in pulverulent to powdery condition containing intimately admixed therewith a minor proportion up to the order of fifteen percent of powder selected from a group consisting of vanadium, chromium, iron and non-acid compounds thereof, said powder being non-acid and adapted to release halogen from the composition on heating.
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