UNITED STATES PATENT OFFICE.

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TIME-BURNING RAILWAY SIGNAL-FUSEE.

1,025,205. Specification of Letters Patent. Patented May 7, 1912.

No Drawing. Application filed February 15, 1912. Serial No. 677,853.

To all whom it may concern:

Be it known that I, LOUIS S. ROSS, a citizen of the United States, and a resident of Newtonville, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Time-Burning Railway Signal-Fusees, of which the following description is a specification.

This invention relates to improvements in time burning railway signal fusees, the primary object thereof being to produce a compound for such purpose that will not spontaneously ignite under conditions to which said railway fusees are necessarily subjected, that will not be extinguished when thrown from a moving train or otherwise subjected to severe shock, and that will burn with distinctive brilliancy without, however, burning with a flame too nearly approaching incandescence.

In most compositions for railway signal fusees produced prior to my invention, there have been certain recognized characteristics of the ingredients contained in the fusees that render the latter extremely susceptible to spontaneous ignition, particularly in the presence of heat or moisture or both.

The railways of the United States for a number of years past have maintained a bureau for the safe transportation of explosives and other dangerous articles. This bureau employs chemists to investigate questions relating to the manufacture of explosives and other dangerous articles, and from time to time makes regulations and issues specifications prescribing the inherent characteristics of time burning railway signal fusees. These regulations must be passed upon and approved by the Interstate Commerce Commission to render them legally binding and effective. In accordance with the requirements of the said bureau, railway signal fusees comprise a paper tube of heavy, tough fiber, in which the composition is packed, carrying at one end a spike adapted to penetrate the railroad ties or bed and having at its opposite end means for igniting the fusee. Railway signal fusees are usually thrown from the rear of a moving train and are necessarily therefore subjected to rough usage. It is therefore necessary to have the paper tube of sufficient strength to withstand this usage without breakage. These fusee paper tubes are therefore made of heavy, tough fiber, as stated, and the railroads require that the finished fusee must stand a relatively heavy specified weight at its center when supported at its ends. One of the tests of the said bureau is that the fusee after burning a number of seconds in air must burn a specified length of time when completely submerged in water. It is further required by the said bureau that the fusee must burn a predetermined specified length of time. It must burn with brilliancy and force of flame and it must burn under either favorable or unfavorable weather conditions. In other words, the railway signal fusee must burn in strong winds or storms or even in pools of water or snowbanks.

By reason of the necessity of burning the tube in uniformity with the burning of the composition and also of the necessity that the composition burn with force and brilliancy, all successful compositions for railway signal fusees heretofore employed have contained sulfur and potassium chlorate as fundamental ingredients, with the single exception that a perchlorate, preferably perchlorate of potassium, has been substituted for the chlorate in a composition containing sulfur.

For many years it has been known that time burning railway signal fusees containing sulfur and potassium chlorate as heretofore combined were subject to spontaneous ignition and combustion due to climatic conditions of heat and moisture, because of the presence of said ingredients in the composition, and attempts have been made for many years by railway chemists and others to overcome this serious defect. Such spontaneous ignition has been attributed to the production by sulfur in the presence of heat or moisture of sulfurous and sulfuric acids, which in the presence of potassium chlorate decompose the latter and generate chlorin peroxid. The formation of sulfuric acid from sulfur requires the presence of oxygen, which is readily obtained in the breaking up of the potassium chlorate, whereby heat is generated, accelerating and helping to continue the reaction until a condition is reached that produces spontaneous combustion.

The so-called chlorate time burning railway signal fuse is composed of chlorate, sulfur, carbohydrate and metallic nitrate in suitable proportions. In order to overcome the tendency to spontaneous ignition characteristic of the chlorate fusee, the so-

called perchlorate fusee has been made by substituting perchlorate of potassium for the chlorate of potassium.

A fusee made of mixtures containing a perchlorate, such as perchlorate of potassium, is recognized to be harder to ignite and more easily extinguished when thrown from a moving train than a fusee of the so-called chlorate type. The so-called perchlorate fusee, in spite of this objection, is used because of its substantial freedom from spontaneous ignition.

Because of the objections to the perchlorate fusee, I have conducted a long series of experiments and tests under commercial conditions to produce a time burning railway signal fusee not subject to spontaneous ignition and combustion and from which the perchlorate is eliminated, but containing sulfur, because of its known advantages, and also containing chlorate of barium, because of my discovery of the peculiar advantages of the latter substance, to be fully set forth hereinafter, such fusee also preferably containing a suitable carbohydrate or carbonaceous material and a suitable metallic salt and preferably a metallic nitrate. I have succeeded as a result of said experiments and tests in producing a barium chlorate fusee which possesses all the advantages of the so-called chlorate fusee and which burns with distinctive brilliancy, with either a red, a yellow or a green flame, and is not subject to spontaneous ignition. In other words, I have succeeded in producing a fusee possessing many advantages both of the chlorate and of the perchlorate fusee.

In accordance with my invention, I preferably provide as customary in the so-called chlorate fusee, a suitable mixture of sulfur, a carbohydrate or carbonaceous material, a metallic salt (preferably a metallic nitrate) and chlorate of barium. The sulfur is employed mainly to increase combustion and to cause the burning of the tube evenly with the composition; the carbohydrate or carbonaceous material furnishes carbon and hydrogen to aid combustion and to smooth and deepen the flame; the metallic salt, preferably of strontium, barium or sodium constitutes the base or main coloring ingredient; and the chlorate of barium not only is used to furnish the principal supply of oxygen, but is used in order to obtain a more distinctive brilliancy of the flame, whether it burn red, yellow or green.

The barium chlorate when combined with the barium nitrate, both of which ingredients when burning give a green flame, produce an exceedingly clear and distinctive and brilliant green flame. In other words, by using barium chlorate in connection with barium nitrate, I gain two advantages; first, I supplement the barium nitrate by another barium salt; and second, I avoid the possibility of tinting the barium flame with the red of the potassium flame and obtain a more intense and clearer green. But whether the barium chlorate be combined with a strontium, barium or sodium nitrate or other metallic salt, it will cause more distinctive brilliancy of the resulting flame. The barium chlorate produces a flame which gives a whitish or silvery appearance; the barium chlorate when combined with the sodium nitrate gives a silvery yellow rather than a golden yellow; and the barium chlorate when combined with the strontium nitrate gives a more brilliant red than is obtained by a combination of strontium nitrate and chlorate of potassium. If too great a quantity of barium chlorate be employed, there would be produced a flame nearly or wholly white, but by regulating the amount of barium chlorate, I thereby obtain more distinctive red, green or yellow flames. In other words, the barium chlorate constitutes an ingredient by the proper regulation of which with other flame-coloring salts I am enabled to obtain distinctively brilliant red, yellow or green flames, which do not verge into each other, as is the case particularly with the red and yellow in certain types of fusees. Certain fusees are made to burn in two or three colors, as, for example, red and yellow, or red, yellow and green, and it is important in such case that these colors be clearly distinctive and not verge the one into the other, as may be the case with certain shades of red and yellow or incandescent red and silvery green as heretofore produced.

The proportions of the ingredients previously referred to as preferably employed in the manufacture of the barium chlorate fusee are preferably as follows:—Barium chlorate 13 to about 19 parts, sulfur 10 to 16 parts, carbohydrate or carbonaceous material 5 to 10 parts, metallic salt or nitrate (strontium, barium or sodium) 65 to 72 parts. To these ingredients I preferably add in accordance with my invention, preferably in a powdered condition, a small quantity of an acid-neutralizing agent capable of neutralizing any acid developed during storage of the fusee. I have obtained excellent results by using a carbonate and preferably calcium carbonate. Preferably the carbonate constitutes about two parts or per cent. of the entire mixture, and should not for best results constitute more than four or five per cent. of the entire composition, as in greater quantities it tends to retard or may materially or wholly prevent combustion. This ingredient is added mechanically to the other ingredients of the composition at any stage in the mixing thereof, or may be added to the other ingredients after they have been assembled or mixed. Although preferably I may add calcium carbonate as an acid-neutralizing agent, I may in certain cases em-

ploy other ingredients, as, for example, potassium carbonate, sodium carbonate, sodium silicate, barium peroxid, calcium hydroxid or air slaked lime. I have, however, obtained the best results by employing a carbonate.

Instead of employing both a metallic nitrate and an acid-neutralizing agent, such as calcium carbonate, I may provide some ingredient or agent taking the place both of such acid-neutralizing agent and metallic nitrate. I have in certain cases found that by employing a metallic salt, a metallic oxid or metallic peroxid, I may overcome the danger of spontaneous ignition. I have in certain cases obtained excellent results by employing barium peroxid or strontium peroxid instead of calcium carbonate and also instead of metallic nitrate. The metallic salt employed by me may be a nitrate, peroxid, oxid, or carbonate of barium, sodium or strontium.

Inasmuch as the spontaneous ignition and combustion of railway fusees do not occur immediately upon manufacture thereof but usually only after an extended period of time, ranging in length from ten to twenty months after manufacture, I have conducted a long series of tests under commercial conditions and have found as a result thereof that the calcium carbonate or certain other agents incorporated in a railway signal fusee in accordance with my invention, neutralize any acid occasioned by the presence of sulfur and chlorate in the co-called chlorate fusee, and thus wholly prevents spontaneous ignition. Time burning railway signal fusees constructed in accordance with my invention have been tested by subjecting them to a temperature of boiling water in the presence of moisture for forty-eight hours, and have successfully stood said test and have also been successfully used under commercial conditions after a sufficient period of time following manufacture indisputably to establish the fact that the railway fusee constituting my invention, having an acid-neutralizing agent incorporated therein, is not subject to spontaneous ignition and combustion. The time burning railway signal fusee made in accordance with my invention combines many advantages of the chlorate fusee and of the perchlorate fusee without the disadvantages of either.

The carbonaceous material employed by me is preferably composed of rosin, charcoal and sawdust and grease, although in certain cases I may employ red gum instead of rosin. The proportions of these ingredients may be varied within the scope of my invention, but are preferably substantially as following:—Rosin 1 to 3%, charcoal 1 to 3%, sawdust and grease 3 to 4%.

During my said tests and experiments I encountered great difficulty in arriving at the proper quantity of calcium carbonate or other acid-neutralizing agent to be combined with the other ingredients and particularly with the sulfur and chlorate of barium fully to neutralize any acid as hereinbefore set forth, and therefore fully to prevent spontaneous ignition and combustion, while at the same time securing the even burning of the composition and the tube. In other words, my said tests and experiments seemed to show that while the addition preferably of calcium carbonate tended to prevent spontaneous ignition due to the presence of sulfur and chlorate of barium, yet when added in quantity then considered necessary fully to prevent the same, the calcium carbonate not only retarded combustion but also caused chimneying of the tube. I have, however, finally succeeded in adding or supplying a sufficient quantity of calcium or other suitable carbonate or acid neutralizing agent to a composition containing sulfur and chlorate of barium fully to prevent spontaneous ignition or combustion while at the same time securing substantially perfect and unretarded combustion of the fusee and preventing chimneying.

I have discovered that under identical conditions by using calcium or other suitable carbonate, and in certain cases by using other acid-neutralizing agents, I can safely vary the proportions of the other ingredients through a wider range, and yet secure a thoroughly effective and commercially satisfactory fusee, than is possible when the calcium or other carbonate or other acid-neutralizing agent is not used. Thus, by employing calcium carbonate or certain other agents, it is possible for me to make a commercially satisfactory and thoroughly efficient fusee more cheaply than heretofore. In other words, the calcium carbonate preferably employed constitutes the element of safety, the presence of which permits greater variation than heretofore in the other ingredients.

Preferably, when I add or supply calcium or other carbonate or other acid-neutralizing agent, which is a combustion retarder, I add a slightly and generally a correspondingly increased amount of combustion producing ingredients, that is, sulfur and chlorate of barium, over that employed under identical conditions of manufacture but without the addition of calcium or other carbonate.

I have herein employed the term "carbohydrate" in a broad and generic sense, and have employed the term "carbonaceous material" to include carbohydrates or hydrocarbons, whether using the latter term narrowly or broadly, and rosin, charcoal, sawdust, grease, etc.

It will be understood from the foregoing description that a fire works compound, such as a railway fusee signal, having barium

chlorate, burns with distinctive brilliancy, and that when I add thereto an acid-neutralizing agent, such as calcium carbonate, I prevent all danger of spontaneous ignition.

Having thus described one embodiment of my invention, and the best manner known to me for carrying the same into effect, I desire it to be understood that the scope of the invention is set forth in the following claims.

Claims:

1. A time burning railway signal fusee comprising essentially a flame-coloring metallic salt, sulfur, carbonaceous material, chlorate of barium and an acid-neutralizing agent.

2. A time burning railway signal fusee comprising essentially a flame-coloring metallic salt, sulfur, chlorate of barium and an acid-neutralizing agent.

3. A time burning railway signal fusee comprising essentially a metallic nitrate, sulfur, a carbohydrate, chlorate of barium and an ingredient mixed therewith and capable of neutralizing any acid developed during storage, said fusee compound burning with brilliancy and force of flame for the purpose described and not subject to spontaneous combustion.

4. A time burning railway signal fusee comprising essentially barium nitrate, sulfur, a carbohydrate, chlorate of barium, and an ingredient mixed therewith and capable of neutralizing any acid developed during storage, said fusee compound burning with brilliancy and force of flame for the purpose described and not subject to spontaneous combustion.

5. A time burning railway signal fusee compound comprising essentially a metallic nitrate, sulfur, a carbohydrate, chlorate of barium and an acid-neutralizing agent in less proportion than the sulfur and insufficient in quantity materially to retard combustion.

6. A time burning railway signal fusee comprising essentially barium nitrate, sulfur, a carbohydrate, chlorate of barium, and an acid-neutralizing agent in less proportion than the sulfur and insufficient in quantity materially to retard combustion.

7. A time burning railway signal fusee comprising essentially a metallic nitrate, sulfur, a carbohydrate, chlorate of barium and carbonate in less proportion than the sulfur and insufficient in quantity materially to retard combustion.

8. A time burning railway signal fusee comprising essentially barium nitrate, sulfur, a carbohydrate, chlorate of barium and carbonate in less proportion than the sulfur and insufficient in quantity materially to retard combustion.

9. A time burning railway signal fusee comprising essentially a metallic nitrate, sulfur, a carbonaceous material, barium chlorate, and an acid-neutralizing agent in less proportion than the sulfur and insufficient in quantity materially to retard combustion.

10. A time burning railway signal fusee comprising essentially barium nitrate, sulfur, a carbonaceous material, barium chlorate, and an acid-neutralizing agent in less proportion than the sulfur and insufficient in quantity materially to retard combustion.

11. A time burning railway signal fusee comprising essentially a metallic nitrate, sulfur, barium chlorate, and an acid-neutralizing agent in less proportion than the sulfur and insufficient in quantity materially to retard combustion.

12. A time burning railway signal fusee comprising essentially barium nitrate, sulfur, barium chlorate, and an acid-neutralizing agent in less proportion than the sulfur and insufficient in quantity materially to retard combustion.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

LOUIS S. ROSS.

Witnesses:

ROBERT H. KAMMLER,

F. IRENE CHANDLER.