# UNITED STATES PATENT OFFICE.

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## COMPOUND FOR TIME BURNING RAILWAY SIGNAL-FUSEES.

1,019,190. Specification of Letters Patent. Patented Mar. 5, 1912.

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*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 Compounds for Time Burning Railway Signal-Fusees, of which the following description is a specification.

This invention relates to improvements in compounds for 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.

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

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 weight of sixty pounds at its center when supported at its ends. In order to produce an effective railway signal, it is imperative that the composition be of such character that the wall of the paper tube be consumed uniformly with the combustion of the composition, in order to prevent the formation of what is technically termed a "chimney," since a chimney will obstruct and obscure the light produced by the composition to such an extent that it cannot be seen effectively from a distance, and the fusee will therefore fail in its intended purpose. One of the tests of the said bureau is that the fusee after burning thirty seconds in air must burn not less than five minutes 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 perchlorate of potassium has been substituted for potassium 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 and 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 re-action until a condition is reached that produces spontaneous combustion.

The so-called chlorate time burning railway signal fusee is composed of chlorate, sulfur, carbohydrate and metallic nitrate in suitable proportions.

The somewhat greater brilliancy of the perchlorate fusee is caused by the increased oxidizing power of the perchlorate of potassium. Perchlorate of potassium differs from chlorate of potassium only in that it contains an added atom of oxygen. This added atom of oxygen with its increased oxidizing power causes a flame which approaches incandescence, so that the flame losses that characteristic color typical of the chlorate fusee and particularly of the red burning fusee, causing the flame to verge more nearly to a white light.

In all time burning railway signal fusees, there is a period in their life known as the "quickening up" of the fusee, by which is meant the tendency to burn for a shorter time than when said fusees were first made. It is essential that fusees burn for a length of time that is within certain specified limits. For example, a ten minute fusee must burn not less than ten minutes, nor more than twelve minutes.

Because of the known susceptibility of a chlorate fusee to spontaneous ignition, 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 both sulfur and chlorate, the presence of which in the chlorate fusee has heretofore produced the tendency to spontaneous ignition, such fusee also preferably containing a suitable carbohydrate and a suitable nitrate. I have succeeded as the result of such experiments and tests in producing a chlorate fusee which possesses all the advantages of the chlorate fusee and is not subject to spontaneous ignition.

In accordance with my invention, I preferably provide, as customary in the so-called chlorate fusee, a suitable mixture of chlorate of potassium, sulfur, a carbohydrate and a metallic nitrate. The chlorate of potassium is used to furnish the principal supply of oxygen, the sulfur mainly to increase combustion, the carbohydrate furnishes carbon and hydrogen to aid combustion and to smooth and deepen the flame, and the nitrate of strontium, barium or sodium constitutes the base or coloring ingredient. Moreover the sulfur is needed to cause the burning of the tube evenly with the composition, that is, to prevent the formation of a chimney. The proportions of these ingredients may be varied within certain limits, but those preferred by me are as follows:—chlorate 13 to about 19 parts, sulfur 10 to 16 parts, carbohydrate 5 to 10 parts, metallic nitrate 65 to 72 parts. To these ingredients I add, in accordance with my invention, preferably in a powdered condition, a small quantity of 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 and mixed.

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 incorporated in a railway signal fusee in accordance with my invention, neutralizes any acid occasioned by the presence of sulfur and chlorate in the so-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 is not subject to spontaneous ignition and combustion.

The time burning railway signal fusee constituting my invention combines all the advantages of the chlorate fusee and of the perchlorate fusee without the disadvantages of either. It has been approved by the Bureau for the Safe Transportation of Explosives and Other Dangerous Articles to which I have referred, because it eliminates the susceptibility or tendency toward spontaneous ignition and combustion characteristic of the said chlorate fusee.

The carbonaceous material heretofore customarily employed in the manufacture of the so-called chlorate fusee has been composed of charcoal, red gum, sawdust and petroleum grease in suitable proportions, and preferably substantially as follows:—red gum 1 to 3%, charcoal 1 to 3%, sawdust and grease 3 to 4%. I have ascertained, as the result of my tests and experiments that the red

gum is objectionable, owing to its high acid producing qualities and have accordingly substituted preferably a substantially equal amount of rosin therefor. During my said tests and experiments, I encountered great difficulty in arriving at the proper quantity of calcium carbonate to be combined with the other ingredients, and particularly with the sulfur and chlorate of potassium, 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 of calcium carbonate tended to prevent spontaneous ignition, due to the presence of sulfur and chlorate of potassium, 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 to a composition containing sulfur and chlorate of potassium fully to prevent spontaneous ignition or combustion while at the same time securing perfect and unretarded combustion of the fusee and preventing chimneying. I have discovered that, under identical conditions, by using calcium or other suitable carbonate 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 is not used. Thus, by employing calcium carbonate, it is possible for me to make a commercially satisfactory and thoroughly efficient fusee more cheaply than heretofore. In other words, the calcium carbonate 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, which is a combustion retarder, I add a slight and generally a correspondingly increased amount of combustion producing ingredients, that is, sulfur and chlorate of potassium, over that employed under identical conditions of manufacture, but without the addition of calcium or other carbonate. The flames of the chlorate fusee and calcium carbonate fusee are identical in color, there being no tendency to incandescence in the flames of the latter.

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:

1. A time burning railway signal fusee comprising a metallic nitrate, sulfur, a carbohydrate, chlorate of potassium and a small quantity of carbonate, producing a time burning railway signal fusee compound burning with brilliancy and force of flame for the purpose stated, and which is not subject to spontaneous ignition.

2. A time burning railway signal fusee comprising a metallic nitrate, sulfur, a carbohydrate, chlorate of potassium, and a small quantity of calcium carbonate, producing a time burning railway signal fusee compound burning with brilliancy and force of flame for the purpose described, and which is not subject to spontaneous combustion.

3. A time burning railway signal fusee comprising a metallic nitrate, sulfur, a carbohydrate and chlorate of potassium, and an ingredient mixed therewith and constituting a neutralizing agent to the acid reaction of the sulfur and chlorate of potassium, 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 containing sulfur, chlorate of potassium and a percentage of acid-neutralizing carbonate less than the sulfur and insufficient in quantity to retard combustion.

5. A time burning railway signal fusee including sulfur, chlorate of potassium, a metallic nitrate and a small percentage of acid-neutralizing carbonate, said fusee burning with brilliancy and force of flame and not subject to spontaneous 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,
IRVING U. TOWNSEND.