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SMOKE AGENT

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to us of any royalty thereon.

This invention relates to a colored smoke-forming composition.

The object of this invention is to provide an economical smoke-producing mixture which is particularly efficient when used in a smoke grenade or candle but which may also be effectively utilized in artillery or mortar projectives, and in smoke pots or various other pyrotechnical devices.

The smoke-forming composition of this invention comprises as principal ingredients a mixture of a suitable dye, a fuel containing potassium chlorate and sulfur, and a combustion-controlling agent, such as sodium bicarbonate or potassium bicarbonate.

In the late war, small, portable, nonmissile devices which produced smoke by progressive burning of a chemical filling were known as smoke candles. Devices of larger size, not so readily portable but producing a more enduring smoke cloud with longer burning by virtue of their size, were called smoke pots. More recently, the smoke candles were developed along the lines of tear gas grenades and became known as smoke grenades. The grenades are a very convenient type of munition. They are easily carried by troops, and they are readily set into action after projection by small arms or when thrown by hand. However, the use of grenades for colored smoke had the serious limitation that known smoke mixtures were unsuitable in being too slow in igniting, too fast in burning, and erratic in burning.

The colored smoke-forming composition of the present invention does not have the limitations of previously known mixtures and has proved to be an efficient filling for utilization in the same kind of container as is used for tear gas grenades.

The composition has been satisfactorily standardized into one type with the following variety of colors:

1. Yellow	4. Green
2. Orange	5. Blue
3. Red	6. Violet

In producing the smoke-forming compositions, it is preferable to have a dry, uniform mixture of the ingredients and to use the ingredients in certain optimum proportions for forming a large amount of smoke.

Examples of satisfactory compositions are as follows:

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Example 1.—Yellow smoke mixture

	Percent
Auramine	38
$KClO_3$—S	33.5
$NaHCO_3$	28.5

Example 2.—Orange smoke mixture

	Percent
Orange dye	45
$KClO_3$—S	31
$NaHCO_3$	24

The orange dye consists of a mixture of 39 parts of 8-chloro-1-aminoanthraquinone and 6 parts of auramine.

Example 3.—Red smoke mixture

	Percent
1-methylaminoanthraquinone	40
$KClO_3$—S	41
$NaHCO_3$	19

Example 4.—Green smoke mixture

	Percent
Green dye	41
$KClO_3$—S	36
$NaHCO_3$	23

The green dye consists of 29 parts of 1, 4-di-p-toluidino anthraquinone and 12 parts of auramine.

Example 5.—Blue smoke mixture

	Percent
Indigo	64
$KClO_3$—S	28
$NaHCO_3$	8

Example 6.—Violet smoke mixture

	Percent
Violet dye	44
$KClO_3$—S	42
$NaHCO_3$	14

The violet dye consists of a mixture of 26 parts of 1,4-diamino-2,3-dihydro anthraquinone and 18 parts of crude 1-methylaminoanthraquinone.

The fuel mixture preferably contains about 72% potassium chlorate and about 28% sulfur.

The following particle sizes are used in the formulations of the foregoing examples, but the particle sizes may be varied depending on the change in composition and on the burning time desired:

Potassium chlorate:

85% minimum passes a No. 100 U. S. Standard sieve

40% minimum passes a No. 200 U. S. Standard sieve

Sulfur:
- 99% minimum passes a No. 100 U. S. Standard sieve
- 85% minimum passes a No. 200 U. S. Standard sieve

Sodium bicarbonate:
- 99% minimum passes a No. 100 U. S. Standard sieve
- 50% minimum passes a No. 200 U. S. Standard sieve

Yellow dye:
- 70% minimum passes a No. 100 U. S. Standard sieve
- 20% maximum passes a No. 200 U. S. Standard sieve

Orange dye:
- 92% minimum passes a No. 100 U. S. Standard sieve
- 16% minimum passes a No. 200 U. S. Standard sieve

Red dye:
- 90% minimum passes a No. 100 U. S. Standard sieve
- 70% minimum passes a No. 200 U. S. Standard sieve

Green dye:
- 95% minimum passes a No. 100 U. S. Standard sieve
- 40% minimum passes a No. 200 U. S. Standard sieve

Blue dye:
- 90% minimum passes a No. 100 U. S. Standard sieve
- 30% minimum passes a No. 200 U. S. Standard sieve

Violet dye:
- 95% minimum passes a No. 100 U. S. Standard sieve
- 60% minimum passes a No. 200 U. S. Standard sieve

Each of the smoke mixture charges may be loaded into a grenade body and compressed therein under a high pressure, e. g., pressure of 475 pounds per square inch. On top the smoke charge in the grenade body may be placed a starter charge formulated from silicon potassium nitrate and charcoal with a binder solution of cellulose nitrate and acetone. The starter mixture may be contained in a starter cup and be ignited by an ordinary grenade fuse made up of a primer and a train of black powder, the primer being set off by mechanical impact of a striker. The smoke mixture may be in any suitable container without a starter cup and can be ignited directly simply by a fuse.

In the operation of a colored smoke grenade, heat evolved by the chemical reaction of the fuel ingredients volatilizes the dye; and the dye vapors dispersed into the atmosphere condense to form a thick colored smoke. The colored smoke, if formed in sufficient volume and lasting for sufficient time, can be observed from long distances and serves as a signal, identification or for a variety of other purposes.

It is found to be extremely important to have the combustion reaction in the smoke mixture controlled in order to keep the temperature sufficiently low to prevent excessive decomposition and flaming of the dye. In general, the dye is an organic substance capable of being ignited at an elevated temperature. The dyes selected should be volatile and thermally stable at the temperature of the burning mixture.

The kinds of dyes found most suitable are commercial dyes as well as dyes specially made; it was found that some anthraquinone dyes, a diphenyl methane dye, an indigo dye and other vat-type dyes could be used.

The use of the agent for controlling the combustion reaction is very important. By moderating the temperature of the reaction without adversely affecting the ignition properties of the mixture, the agent makes possible the selection of suitable organic dyes, lengthens the time of burning and increases the smoke-developing efficiency of the mixture. A characteristic of the combustion-controlling agent is the property of decomposing when heated to within the temperature range of about 100° C. to 350° C., more preferably in the range of 200° C. to 300° C. Compounds having this characteristic are basic alkali bicarbonates, such as sodium bicarbonate and potassium bicarbonate.

It is to be understood that the invention is not limited by the specific examples and that various modifications are included within the scope of the invention.

We claim:

1. A colored smoke forming composition comprising a dry fuel mixture of sulfur and potassium chlorate, a combustion controlling agent in a proportion of from about 8% to 28.5% $NaHCO_3$ and a dyestuff consisting by weight of from not less than 35% nor more than 45% of said composition selected from a group consisting of 1 methylaminoanthraquinone, 1,4-diamino-2,3-dihydro anthraquinone and a mixture of each of said quinones.

2. A colored smoke forming composition comprising a dry fuel mixture of sulfur and potassium chlorate, a combustion controlling agent in a proportion of from about 8% to 28.5% $NaHCO_3$ and a dyestuff consisting by weight of from not less than 35% nor more than 45% of said composition consisting of 1 methylaminoanthraquinone.

3. A colored smoke forming composition comprising of a dry fuel mixture of sulfur and potassium chlorate, a combustion controlling agent in a proportion of from about 8% to 28.5% $NaHCO_3$ and a dyestuff consisting by weight of from not less than 35% nor more than 45% of said composition selected from 1,4-diamino-2,3-dihydro anthraquinone.

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