

# I.

The invention relates to a pyrotechnic composition for the production of a camouflage fog.

Compositions of this kind are already known per se: hygroscopic compounds such as metal chlorides ( $\text{ZnCl}_2$ ,  $\text{FeCl}_3$ ,  $\text{AlCl}_3$ ,  $\text{TiCl}_4$ ,  $\text{SiCl}_4$ ) or phosphorous oxides ( $\text{P}_2\text{O}_3$ ,  $\text{P}_2\text{O}_5$ ) are produced and evaporated, after which they hydrolyse with the air and form fog clouds suitable for camouflage purposes. For the mechanism of this fog production reference should be made to the following literature: H. Ellern, Military and Civilian Pyrotechnics, Chem. Publ. Comp. Inc., N.Y., 1968, pp. 147-151; John A. Conkling, Chemistry of Pyrotechnics, Marcel Dekker Inc., N.Y., 1985, pp. 174, 175.

The fog formed, particularly from so-called HC fog compositions containing hexachlorethane, but also from phosphorus fog compositions, is highly acid in consequence of the hydrolysis with damp air, since hydrochloric acid (HC fog) and phosphoric acids in particular are created, rendering the fog toxic and harmful to vegetation.

In addition, in the case of the most frequently used fog composition with a hexachlorethane (HC) base and with fine or zinc oxide, the heavy metal, zinc, passes into the environment.

There has been ample experimentation for the purpose of overcoming these drawbacks. The pyrotechnic fog compositions described in Ger. Pat. 27 43 363 and Ger. Pat. Appl. 28 19 850, for example, are built up in such a manner that the acid effect of the fog produced is partly or completely nullified by the corresponding chemical complex formation or by neutralization of the  $\text{ZnCl}_2$  created or of the phosphoric acids.

The formation of toxic substances harmful to the environment nevertheless continued.

The purpose of the invention is therefore to produce a camouflage fog which will prove particularly suitable for training purposes and which consists of a non-toxic aerosol and can thus exert no toxic effects on humans or animals, in addition to being environment-friendly. If the use of the optionally mentioned NaCl is omitted the fog mainly consists of macronutrients suitable for vegetation.

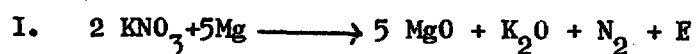
The essential characteristics of the invention which are necessary for the achievement of its object are indicated in Patent Claim 1. The subsidiary claims indicate examples for the performance of the invention.

The invention provides a non-toxic fog of sufficient optical density.

The fog is formed in the following manner: the constituents magnesium powder, potassium nitrate and potassium perchlorate, already produce fog-like clouds when converted at about 2500°. The density of the fog is improved, in particular, by the proportion of potassium chloride and/or sodium chloride, of which the sublimation point of about 1500° and melting point of about 1450° C are far below the reaction temperature for magnesium and potassium nitrate. The products of the chemical reaction of magnesium with potassium nitrate, potassium perchlorate, calcium carbonate etc. thus form in conjunction with the sublimating potassium chloride or evaporating sodium chloride a usable training fog without any toxic or environmentally harmful content.

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The chemical reactions in the fog composition can be expressed on simplified lines by the following three equations:



The energy (E) released in the three basic reactions mentioned serves for the sublimates/evaporation of potassium chloride and sodium chloride.

To improve the control of the consumption due to combustion the mixture is given an addition of substances which, in particular, split off nitrogen, such as azodicarbonamides, oxamide or dicyanodiamide. This ensures a continuous flow of gas for the more complete transport of the aerosol particles and a higher aerosol yield, as the gases formed permanently prevent the slag from coalescing and assist the sublimation and evaporation by increasing the surface area.

As the composition burns away a purely white aerosol forms of which the main constituents are potassium chloride, magnesium oxide, calcium hydroxide, calcium carbonate, sodium chloride and potassium carbonate. These are environment-friendly and, except for the NaCl, macronutrients for vegetation.

The pH value of the fog produced is at its highest (9) in the place where it occurs. As a result of chemical reactions between the oxides  $\text{K}_2\text{O}$  and  $\text{CaO}$  (equations 1,3) and constituents of the air, particularly

$H_2O$  and  $CO_2$ , these reactions being accompanied by the formation of  $KHCO_3$ ,  $K_2CO_3$ ,  $Ca(OH)_2$  and  $CaCO_3$ , and as also as a result of dilution, the pH value rapidly decreases so that at a distance of 5-10m from the location of the fog it reaches the pH value of the ambient air (appr.6).

The ignition mixture may consist of a pyrotechnic composition with the same constituents as the mixture used for the production of the camouflage fog, although the proportion of magnesium and oxidizing compound is increased in order to improve the ignition response and certainty of transmission. The ignition composition may consist, for example, of the following proportions: 25% Mg, 35%  $KNO_3$ , 10%  $KClO_4$ , 20%  $CaCO_3$ , 10% KCl.

The fog composition and ignition composition are pressed into casings in the manner known per se and caused to react by conventional ignition agents.

The drawing shows a version of a fog unit with the new composition. A casing 1 with a base 3 contains the compressed mixture 4, sealed off with the ignition mixture 5 pressed onto it. The example shown in the drawing has a recess 6 for the insertion of an ignition agent known per se.

Preferred versions of the mixture are given in the following table:

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(a) Mg 15%

$\text{KNO}_3$  30%

$\text{KClO}$  -%

$\text{CaCO}_3$  15%

$\text{KHCO}_3$  -%

$\text{KCl}$  32%

$\text{NaCl}$  -%

Azodicarbonamide 8%

(b)

Mg 12%

$\text{KNO}_3$  25%

$\text{KClO}_4$  5%

$\text{CaCO}_3$  18%

$\text{KHCO}_3$  2%

$\text{KCl}$  30%

$\text{NaCl}$  -%

Oxamide 8%

(c)

Mg 20%

$\text{KNO}_3$  20%

$\text{KClO}_4$  8%

$\text{CaCO}_3$  -%

$\text{KHCO}_3$  12%

$\text{KCl}$  15%

$\text{NaCl}$  15%

Dicyanodiamide 10%



CLAIMS

1. Pyrotechnic composition for production of a camouflage fog, comprising a metal powder as a reducing agent, at least one oxidizing agent, at least one combustion rate moderator and at least one fog producer, characterised by a light-metal powder as the metallic reducing agent, potassium nitrate ( $\text{KNO}_3$ ) or a mixture of potassium nitrate ( $\text{KNO}_3$ ) and potassium perchlorate ( $\text{KClO}_4$ ) as main oxidizing agent, at least one carbonate, for example calcium carbonate ( $\text{CaCO}_3$ ), potassium hydrogen carbonate ( $\text{KHCO}_3$ ), sodium hydrogen carbonate ( $\text{NaHCO}_3$ ), potassium carbonate ( $\text{K}_2\text{CO}_3$ ), sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) and nitrogen liberating substances as moderators and potassium chloride ( $\text{KCl}$ ) as a sublimable and/or common salt ( $\text{NaCl}$ ) as an evaporable, non toxic fog producing substance.

2. Composition in accordance with Claim 1, characterised by the fact that the light-metal powder comprises magnesium powder ( $\text{Mg}$ ).

3. Composition in accordance with Claim 1, characterised by azodicarbonamide ( $\text{NH}_2\text{-CO-N=N-CO-NH}_2$ ), oxamide ( $\text{CONH}_2$ )<sub>2</sub> or dicyanodiamide ( $\text{NH=C(NH}_2\text{)NH-CN}$ ) as



nitrogen liberating substance.

4. Composition in accordance with one of Claims 1 to 3, characterised by the following proportions in percentages by weight:

|                                                                                                            |        |                |
|------------------------------------------------------------------------------------------------------------|--------|----------------|
| Mg                                                                                                         | 10-25% | preferably 15% |
| KNO <sub>3</sub>                                                                                           | 20-36% | " 25%          |
| KClO <sub>4</sub>                                                                                          | 0-15%  | " 5%           |
| CaCO <sub>3</sub>                                                                                          | 0-20%  | " 12%          |
| KHCO <sub>3</sub> , NaHCO <sub>3</sub> , K <sub>2</sub> CO <sub>3</sub> or Na <sub>2</sub> CO <sub>3</sub> | 0-10%  | " 3%           |
| KCl/NACl                                                                                                   | 20-50% | " 30%          |
| Azodicarbonamide, oxamide<br>or dicyanodiamide                                                             | 5-20%  | " 10%          |

5. Composition in accordance with Claim 4, characterised by the fact that the mixture (4) is pressed into a casing (1) and is provided at an end with an ignition mixture (5).

6. Ignition mixture in accordance with Claim 4, characterised by the fact that it comprises the same constituents as the fog producing composition but in different quantitative proportions, preferably 25% Mg, 35% KNO<sub>3</sub>, 10% KClO<sub>4</sub>, 20% CaCO<sub>3</sub> and 10% KCl.