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3,274,035

**METALLIC COMPOSITION FOR PRODUCTION OF  
HYGROSCOPIC SMOKE**

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Calif., assignors to the United States of America as  
represented by the Secretary of the Navy  
No Drawing. Filed June 15, 1964, Ser. No. 375,402  
4 Claims. (Cl. 149—40)

The invention herein described may be manufactured  
and used by or for the Government of the United States  
of America for governmental purposes without the pay-  
ment of any royalties thereon or therefor.

This invention relates to new compositions for pyro-  
technic production of hygroscopic smokes.

Many compositions and methods are known to the art  
for producing smokes for concealment purposes as well  
as cloud seeding. A variety of haloid compositions have  
been made which are said to produce hygroscopic smoke.  
They consist essentially of an admixture of an oxidant,  
a fuel, a halogen donor and a halogen receptor. Other  
substances, which dispersed, have cloud nucleating char-  
acteristics include the well-known iodides, silver, lead,  
and copper, cupro-oxide, copper sulphide, copper selenide,  
mercury telluride, vanadium pentoxide, silver sulphide,  
silver nitrate, silver oxide and cadmium telluride. The  
pyrotechnic generation of zinc, aluminum and magne-  
sium chlorides by the reaction of these metals in pow-  
dered form with carbon tetrachloride and hexachloro-  
ethane with other additives for the production of smokes  
for concealment purposes is well-known. These materi-  
als have fairly low hygroscopicities. Since dispersion  
of many of the above-mentioned cloud nucleating materi-  
als is accomplished by use of concentrated solutions  
in spray-type devices, the total effectiveness is reduced.  
The present invention provides compositions which show  
as good capability of forming nuclei for cloud seeding  
as any of the compositions used heretofore, and is sim-  
ple and easy to obtain.

It is therefore an object of this invention to provide  
a composition which produces hygroscopic smoke for  
use in influencing the weather.

Another object is to provide a material which can be  
used for clearance of fog from large areas such as air-  
craft runways.

Yet another object is to produce a hygroscopic smoke  
for inducing precipitation from warm clouds.

Other objects, features and many of the attendant ad-  
vantages of this invention will become readily appreciated  
as the same become better understood by reference to  
the following detailed description:

The present invention is for a composition which upon  
combustion yields hygroscopic smoke. It comprises a  
carbonate selected from the group consisting of lithium,  
sodium, potassium, cesium, rubidium, calcium, magne-  
sium, strontium and barium carbonates and mixtures  
thereof; a light metal selected from the group consist-  
ing of aluminum, magnesium, zinc and zirconium and  
mixtures thereof; and an inorganic oxidizer selected from  
the group consisting of nitrates and perchlorates of so-  
dium, lithium, potassium, calcium, barium and strontium;  
and a polyhalogen compound selected from the group  
consisting of hexachloroethane and octachloropropane.  
The percentages used must be such that stoichiometric  
reactions occur and complete volatilization of the com-  
bustion products is obtained.

The following examples better illustrate this invention  
but should not be considered as limiting.

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*Example I*

| Ingredients:          | Percent by weight |
|-----------------------|-------------------|
| Lithium carbonate     | 19.34             |
| Hexachloroethane      | 20.66             |
| Aluminum              | 20.50             |
| Potassium perchlorate | 39.50             |

This composition burns completely and leaves no resi-  
due, i.e., all the reaction products are volatilized. The  
percentages of lithium carbonate and hexachloroethane  
may vary from the values stated so long as their mutual  
proportions remain the same.

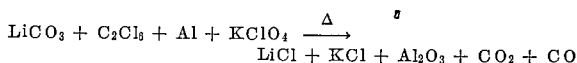
The ingredients are blended and compression molded  
into appropriate containers.

*Example II*

| Ingredients:          | Percent by weight |
|-----------------------|-------------------|
| Lithium carbonate     | 16.9              |
| Hexachloroethane      | 18.1              |
| Aluminum              | 22.3              |
| Potassium perchlorate | 42.7              |

The above composition was mixed and pressed into  
a cylinder one-inch diameter, one-half inch long with a  
one-fourth inch hole. This cylinder was ignited using  
a loose packed mixture of 2.42% lithium carbonate,  
2.58% hexachloroethane, 32.5% aluminum and 62.50%  
potassium perchlorate in the hole as an igniter. The  
composition burned, leaving no residue and producing  
a white smoke cloud. The solid matter in the cloud was  
sampled using a cold metal plate and the solid products  
were identified as aluminum oxide ( $\text{Al}_2\text{O}_3$ ), potassium  
chloride (KCl) and lithium chloride (LiCl). The solid  
product was quite hygroscopic and absorbed water from  
the atmosphere, although the relative humidity at the  
time was probably below 5%.

The decomposition of this new composition may be  
represented by the following unbalanced equation:



Obviously many modifications and variations of the  
present invention are possible in the light of the above  
teachings. It is therefore to be understood that within  
the scope of the appended claims the invention may be  
practiced otherwise than as specifically described.

What is claimed is:

1. The composition which produces hygroscopic smoke  
comprising an admixture of the following ingredients:

| Ingredients:          | Percent by weight |
|-----------------------|-------------------|
| Lithium carbonate     | 19.34             |
| Hexachloroethane      | 20.66             |
| Aluminum              | 20.50             |
| Potassium perchlorate | 39.50             |

2. The composition which produces hygroscopic smoke  
comprising an admixture of the following ingredients:  
Aluminum

Potassium perchlorate

Lithium carbonate

Hexachloroethane;

the percentage of said ingredients being such that  
upon combustion of said composition a stoichi-  
ometric reaction occurs.

3. A composition which produces hygroscopic smoke  
comprising the following components:

| Components               | Parts by weight |
|--------------------------|-----------------|
| Pyrotechnic mixture      | 1.5             |
| Smoke generating mixture | 1               |

said pyrotechnic mixture consisting essentially of aluminum and potassium perchlorate; and said smoke generating mixture consisting essentially of lithium carbonate and hexachloroethane.

4. A composition which produces hygroscopic smoke 5 comprising the following ingredients:

a carbonate selected from the group consisting of sodium, potassium, cesium, rubidium, calcium, magnesium, strontium and barium carbonates and mixtures thereof;

a light metal selected from the group consisting of magnesium, zinc, aluminum and zirconium and mixtures thereof;

an inorganic oxidizer selected from the group consisting of sodium perchlorate, lithium perchlorate, potassium perchlorate, calcium perchlorate, barium perchlorate, strontium perchlorate and the corresponding nitrates, and mixtures thereof;

a polyhalogen compound selected from the group consisting of hexachloroethane and octachloropropane; 20 the percentages of said ingredients being such that upon combustion of the composition a stoichiometric reaction occurs.

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