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Serpolay

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[54] **PROCESS FOR LOCAL MODIFICATION OF THE STRUCTURE OF FOG AND CLOUDS FOR TRIGGERING THEIR PRECIPITATION AND FOR HINDERING THE DEVELOPMENT OF HAIL PRODUCING CLOUDS**

[75] Inventor: **Roger Rene Serpolay**, Brest, France

[73] Assignee: **Etat Francais**, Paris, France

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** .... **239/2 R**

[51] **Int. Cl.²** **E01H 13/00**

[58] **Field of Search** .... 239/2 R, 14; 260/209.6; 252/194, 319

[56] **References Cited**

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Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—John J. Love
Attorney, Agent, or Firm—Larson, Taylor and Hinds

[57] **ABSTRACT**

The dispersing of hydrophilic sodium alginate particles in fog and clouds has been found to modify their structure, trigger their precipitation and hinder the development of hail-producing clouds.

2 Claims, 2 Drawing Figures

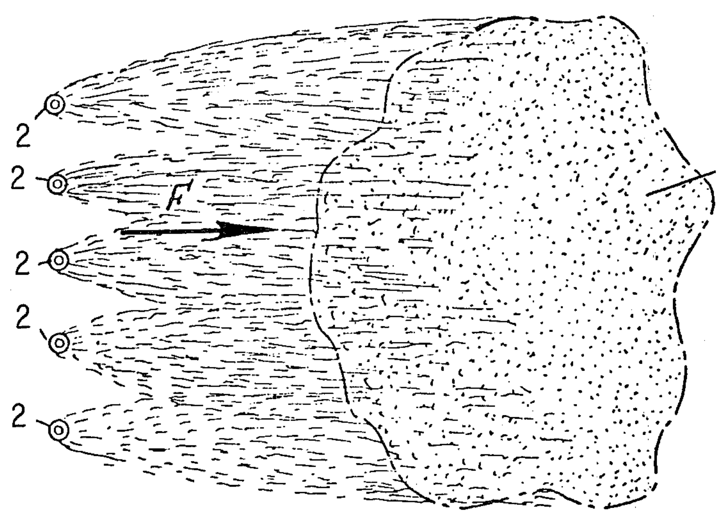
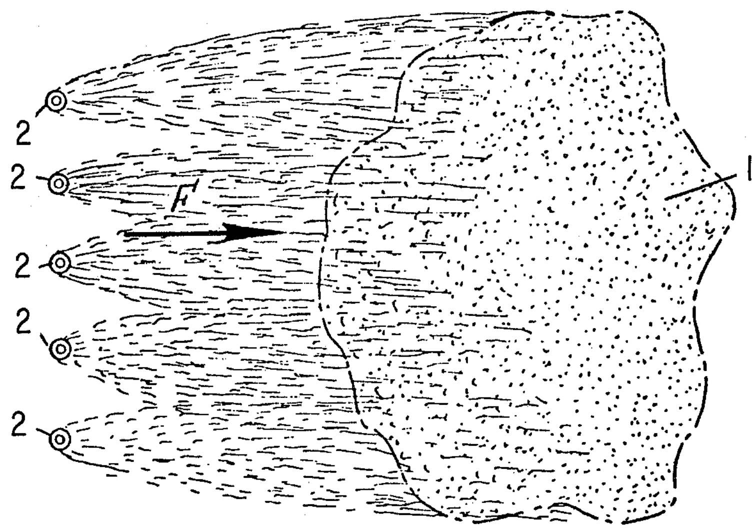


FIG. 1


2
2
F
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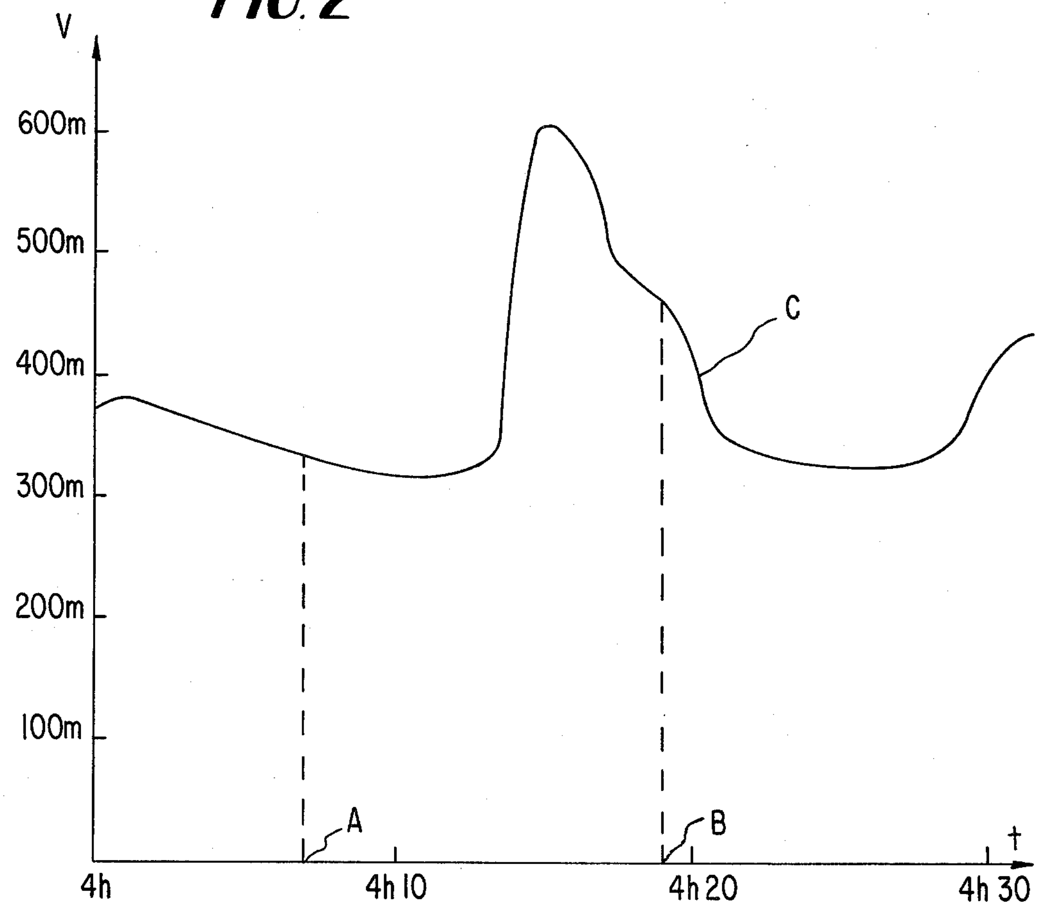
1

FIG. 2


V
600m
500m
400m
300m
200m
100m
C
A
B
t
4h
4h 10
4h 20
4h 30

PROCESS FOR LOCAL MODIFICATION OF THE STRUCTURE OF FOG AND CLOUDS FOR TRIGGERING THEIR PRECIPITATION AND FOR HINDERING THE DEVELOPMENT OF HAIL PRODUCING CLOUDS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a process that allows local modification of the structure of fog and clouds, and the triggering of their precipitation. The invention also concerns a process that permits the thwarting of the development of hail-producing clouds.

2. Description of the Prior Art

The difficulties inherent in fog are well known, and we know how important it is to be able locally to precipitate a sheet of fog e.g. above an airport, to allow takeoff and landing of aircraft. There is also interest in being able to trigger precipitation of clouds so as to hinder development of hail-producing clouds thereby preventing the formation of hail.

Numerous experiments have been carried out to try to resolve these problems. The experiments thus far have consisted principally in dispersing in the fog or clouds particles of a substance that has the property of condensing or absorbing the water of the microscopic droplets which constitute the fog or clouds. It was hoped that in this way that the fine water droplets, with an average size of 5 to 20 microns, constituting the fog and clouds, could be replaced by a smaller number of larger particles that could be precipitated.

Thus experiments have been conducted involving the dispersion of microcrystals of ice or of substances such as silver iodide in supercooled clouds or fog, i.e., formed in air at a temperature below 0°C. Using these known procedures, supercooled fogs and clouds have been precipitatable as snow.

Attempts to precipitate natural fog formed at temperatures above 0°C have made use of hygroscopic substances such as sodium chloride. The results of these attempts were inconclusive and generally negative in the situation where the fog sheet has a thickness of the order of or less than several tens of meters.

Similarly, experiments so far aimed at prevention of development of hail-producing clouds have not yielded significant results.

SUMMARY OF THE INVENTION

The purpose of the present invention is to remedy the aforementioned drawbacks, presenting a simple and efficient process that allows both the local modification of the structure of fog and clouds, triggering their precipitation, and the thwarting of the development of hail-producing clouds.

According to the process of the invention, particulate or powdered hydrophillic substance comprising sodium alginate is dispersed in the fog or in the cloud.

It is known that sodium alginate is a solid product derived from alginic acid (algin) extracted from brown algae called Laminariaceae. Alginic acid is a polymerized organic compound whose chain is formed from mannuronic acid and guluronic acid in variable proportions.

Sodium alginate is a cream colored powder, soluble in cold water, forming therewith a colloidal viscous solution and is used mainly in the manufacture of ice cream in which it acts as a stabilizing agent that can

prevent the development of large ice crystals (see Merck Index 18th ed., page 31).

Since sodium alginate is characterized principally by the property of being hydrophilic, hence of absorbing water in the vapor and liquid phase, when sodium alginate particles are put in suspension in a humidity saturated atmosphere, which is the case with fog and clouds, the particles are able to absorb several times their weight in water. This absorption is explained by the great affinity of sodium alginate for water, which is promoted by the tubular configuration of the macromolecules that constitute it. Similarly, when a liquid water droplet comes into contact with the surface of a sodium alginate particle, it is immediately taken over by the particle. Because of these two processes, the sodium alginate particles increase in size to become elements loaded with water that can precipitate.

According to a preferred embodiment of the invention, the sodium alginate has a particle size below 70 microns, on an average 30 microns. Thus the sodium alginate particles dispersed in the clouds or in the fog have dimensions close to the droplets constituting the clouds or fog, which allows the particles to remain in suspension in the clouds and fogs for a sufficient period of time so that the absorption in the vapor phase will be as efficient as possible, and so that the probability of contact of the particles with the droplets will be maximal.

According to another preferred embodiment of the invention the sodium alginate, in aqueous solution at 1.2 percent by weight, at 18°C, having a viscosity above 600 centipoises is found especially applicable for hindering development of hail-producing clouds. It is known that high turbulence prevails in hail-producing clouds in the course of their development, and that the water droplets that the clouds contain are the seat of a permanent multiplication by chain reaction. The chain reaction process has been described by I. Langmuir in "Final report: project cirrus" Contract no. W36-039-SC-32427 pages 49–70. The dispersion of sodium alginate particles according to the invention with the above mentioned viscosity in the heart of the hail-producing clouds has the effect of inhibiting and braking the process of droplet multiplication. Without the invention being bound to this explanation, it appears the sodium alginate particles, by contact with the droplets of the cloud, form drops of viscous solution of dimensions that are clearly larger, being subject to precipitation without division, toward a lower altitude where the risk of congelation, i.e. hail formation, is considerably less. Because they contain sodium alginate, these viscous drops, moreover, have the advantage of solidifying at temperatures below those at which pure water droplets of the same size would congeal; hence the risk of hail formation is further limited.

Other details of the invention will become evident from the following description.

There are described below several non-limiting examples which refer to different applications of the process of the invention.

DESCRIPTION OF THE DRAWINGS

In the attached drawings:

FIG. 1 schematically shows the process of the invention for modification and local precipitation of fog;

FIG. 2 shows, as a curve, results of tests made in the framework of the application as illustrated in FIG. 1.

The following examples are included to further illustrate the present invention.

EXAMPLE I

Application to Modification and Triggering of Local Precipitation

It is proposed to dissipate locally a blanket of fog 60 to 80 meters thick above an area designated by numeral **1** in FIG. **1.** For this, along a line perpendicular to the direction of the wind component, upstream of area **1** with reference to the direction of the said component (indicated by arrow F) a series of apparatus **2** is disposed, said apparatus being capable of dispersing sodium alginate particles in the atmosphere.

Apparatus **2** are of a known type comprising a tank for the product that is to be dispersed in the atmosphere and a blower device connected to the tank, communicating with a vertical pipe.

These apparatus send the powdery product to a height ranging from 4 to 6 meters above the ground. The product is entrained toward area **1** by the wind.

In the test example, apparatus **2** were disposed at a distance equal to about 400 m from area **1** and the wind velocity was of the order of 2 m/sec.

Apparatus **2** were moreover separated from each other by about 60 to 80 meters distributed along a front corresponding substantially to that of area **1.**

In this test example, sodium alginate was used, with a particle size less than 70 microns, averaging 30 microns, and having in a 1.2 percent by weight aqueous solution at 18°C a viscosity between 400 and 600 centipoises. This value was determined with a Brook Field R.V.S. viscosimeter.

The sodium alginate corresponds to a product called Nouralgine F 300 HV 60 (trade mark) sold by Societe Carbonisation et Charbons actifs (C.E.C.A.).

Two hundred and fifty kg of this product were dispersed in the course of 6 minutes at a rate of the order of 8 kg/min per apparatus **2,** and the following observations were made:

It was found that in area **1,** a short time after the start of product dispersion, there was precipitation of large particles with a diameter greater than 100 microns, and at the same time it was noted that there was a considerable increase in visibility in area **1.**

Visibility was recorded in area **1** by means of an IMPULS (trade mark) videograph before, during and after dispersion of the sodium alginate particles.

The curve thus recorded and reproduced in FIG. **2** gives on the ordinates, visibiility V in meters and on the abscissa, time t. This curve C shows that the visibility, originally about 300 m, rapidly increased to 600 m, 6 to 7 minutes after instant A when product dispersion started. Visibility then decreased, to return to its original value several minutes after instant B, corresponding to the end of product dispersion.

When visibility returned to its initial value, it was noted that the large particles in the fog has disappeared.

These observations, together with the fact that the elapsed time between instant A when the dispersion of the product began and the instant when visibility reached its maximum corresponded rather exactly with the time the sodium alginate particles took to travel the distance between apparatus **2** and area **1,** do not leave room for any doubt as to the effective action of the sodium alginate particles on the fog.

EXAMPLE II

Application to the Triggering of Cloud Precipitation

For such an application, a sodium alginate can be dispersed in the cloud, in 1.2 percent by weight aqueous solution at 18°C, with a viscosity of 100 to 400 centipoises, the particle size here being as in the previous example less than 70 microns, averaging 30 microns.

In the case of a Cumulus cloud in contact with a mountain peak, means for dispersion can be the same as those in the previous example. However, use would generally be made of an airplane with a spray system similar to that used in agriculture for dusting.

Excellent results can be obtained by thus dispersing quantities of 50 to 200 kg sodium alginate during periods that range from 10 to 30 minutes.

EXAMPLE III

Application to Modification of Hail Producing Clouds

It is proposed to act ahead of time on the development of a hail-producing cloud, to prevent formation of hail. In such an application, it is indispensable to be able to replace the original water droplets with very viscous, larger drops.

For this, there is provided use of sodium alginate particles smaller than 70 microns, averaging 30 microns, having a viscosity of 600 to 1200 poises in 1.2 percent by weight aqueous solution.

The sodium alginate particles can be dispersed in hail-producing clouds in the course of development using an airplane equipped with a spray device, the quantity of the dispersed product being of the order of a ton.

It is likewise conceivable that a rocket or similar projectile could be used, capable of dispersing the product on part of its trajectory, corresponding to its passage through the cloud.

Use of sodium alginate to modify the structure of fog and clouds, to trigger precipitation and to hinder formation of hail-producing clouds has the following additional advantages:

- storing sodium alginate involves no problem, on condition that the product be protected from excessive humidity, which is a distant advantage over sodium chloride or other hygroscopic mineral salts that, to remain finely divided, must be mixed with anti-clumping materials;
- with reference to many mineral salts, sodium alginate has the additional advantage of being much less corrosive, and of not being toxic to plants or animals.

Another advantage of the invention is that in precipitation of fogs in urban or industrialized areas, there is also precipitation to the ground of liquid and solid pollutants suspended in the fog. The invention thereby is a means for combatting pollution.

It is claimed:

1. A method for locally triggering the precipitation of fog and clouds which comprises dispersing in the fog or clouds, particles of sodium alginate having a viscosity of 100 to 400 centipoises in 1.2 percent by weight aqueous solution at 18°C.

2. A method for hindering development of hail-producing clouds which comprises dispersing in said clouds particles of sodium alginate having a viscosity of 600 to 1200 centipoises in 1.2 percent by weight solution at 18°C.

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