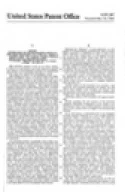
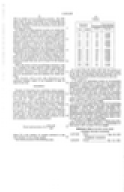
Generation of ice-nucleating crystal

US 3127107 A

IMAGES (2)





Publication number	US3127107 A
Publication type	Grant
Publication date	Mar 31, 1964
Filing date	May 29, 1961
Inventors	John Patrick Merryweather
Export Citation	BiBTeX, EndNote, RefMan

Patent Citations (2), Referenced by (13), Classifications (8)

External Links: USPTO, USPTO Assignment, Espacenet

DESCRIPTION (OCR text may contain errors)

United States Patent "cc 3,127,107 GENERATION 0F ICE-NUCLEATENG CRYSTALS John Patrick Merryweather, New Castle, Pa., assign'or to Canadian Safety Fuse Company Limited, Montreal, Quebec, Canada, a corporation of Canada No Drawing. Filed May 29, 1961, Ser. No. 113,063 4 Claims. (Cl. 239-2) This invention pertains to the art of cloud seeding. It relates to a new process and a new device for generating crystals of ice-nucleating materials for introduction of the same into supercooled atmospheric clouds.

The seeding of clouds, i.e. the introduction into supercooled atmospheric clouds of materials which cause the formation of ice crystals in the clouds, has been practised for a number of years for the purpose of controlling or modifying weather conditions. One method of cloud seeding is described in United States Patent No. 2,570,867 issued on October 9, 1951, to V. J. Schaefer, and consists of introducing into the clouds particles of solid carbon dioxide, the latter producing within the clouds zones of low temperature at which ice crystals form spontaneously. A preferred method, however, is that disclosed in United States Patent No. 2,527,231 issued on October 24', 1950, to V. J. Schaefer and B. Vonnegut, and consists of introducing into the clouds crystals of materials foreign with respect to the clouds and having a space group and unit cell dimensions closely approximating those of ice crystals, the said foreign crystals acting as nuclei for the formation of ice crystals the clouds. Such foreign crystalline materials are known in the art as ice-nucleate ing materials and include chemical substances such as silver iodide, lead iodide, cupric sulphide, etc., as Well as natural minerals such as zincite, nephelite and apatite, A list of ice-nucleating materials is given at page 227 of Physics of Precipitation, Publication No. 746 (1960) of the American Geophysical Union of the National Academy of Sciences-National Research Council. It is with the latter preferred method that the present invention is concerned. 7

Ice-nucleating crystals, in particular silver iodide crystals, have heretofore been generated for introduction into clouds by means of special generators located on the ground or attached to aircraft. In these generators, the ice-nucleating materials are placed in a zone maintained at a temperature at which they have an appreciable vapour pressure, which in the case of silver iodide is at least 1500 C., and are thus vapourized into the atmosphere where they recrystallize upon contact with the coolor In the case of generators located on the ground, the crystals are carried aloft by ascending air currents whereas aircraft generators produce the crystals within or in the near vicinity of the clouds. Typical generators are devices where a solution of silver iodide in acetone is injected or sprayed into a propane, oxyapropane or hydrogen flame or where coke impregnated with silver iodide is burned in an air-blown crucible furnace or where a rope or wick impregnated with silver iodide is burned in an open flame or in an air-propane blast turnace.

3,127,17 Patented Mar. 31, 1964 Although the efficiency of such generators, i.e. the number of crystals thereby produced per gram of silver iodide consumed, is satisfactory in that it varies from 10 to 10 their output rate, i.e. the number of crystals produced per second, varies trom 10 to 3x10 and is thus relatively low. This is particularly undesirable in the case of ground generators since the crystal must ascend to considerable heights before reaching clouds and are thus subject to greater diffusion during their ascent. In addition, the use of such generators is expensive due to their cost of manufacture, transportation and upkeep. It is an object of this invention to provide a process for generating crystals of ice-nucleating materials tor introduction of the same into supercooled atmospheric clouds, which process constitutes a complete departure from the prior art.

Another object or" this invention is to provide a new device for the aforesaid generation of crystals, the said device being simpler, more versatile and cheaper than the generators of the prior art and having'a much greateroutput rate than such generators.

Additional objects of the invention will appear hereinafter.

. Broadly speaking, the new process of this invention comprises detonating contiguously to the clouds a detonating fuse whose core of high explosive contains from about 3.5% to about 20% by weight of an ice-nucleating material.

As is Well known, a detonating fuse is an elongated cord-like material consisting of a core of high explosive contained within a waterproof covering and reinforced with various countering materials and has a velocity of detonation of the order or" 20,000 feet per second. A typical fuse comprises a core of pentaerythritol tetran-itrate, a textile sheath surrounding said core to contain the same, an asphalt layer surrounding said sheath to waterproof it and prevent said core from sifting, a braided textile layer protecting said asphalt layer, a tape covering for said textile layer to provide for the water proofing and flexibility, a second textile sheath surrounding said tape covering to protect it, and a waterproofing layer of 'Wax or plastic surrounding said second textile sheath.

It has been found that by incorporating the aforesaid amount of ice-nucleating material into the high explosive core of detonating fuse, an enormous instantaneous rate of ice-nucleating crystal generation is obtained upon detonation of the fuse which cannot be matched by any other known process and/or device. Thus it has been found that a detonating fuse whose core contains 10 grains per foot of silver iodide and 50 grains per foot of pentaerythritol tetranitrate releases on detonation 10 crystals of silver iodide per 18" length while detonating at the rate of 20,000 feet per second. The eflicieny of such a fuse is lower than that of prior art generators in that it ranges from 32x10 to 1.7)(10 but is very largely offset by its high output rate.

The new ice-nucleating crystal generator of this invention thus consists of a detonatin-g fuse having a core of high explosive containing from about 3.5% to about 3 20% by weight of an ice-nucleating material. The 20% upper limit .on the concentration of ice-nucleating material in the explosive core of the fuse is set by the fact that the efiiciency of the fuse decreases as the said concentration increases.

In addition to being superior to prior art crystal generators from the standpoint of output rate as mentioned above, the new fuse of this invention is of: simpler and cheaper construction and requires no upkeep and it is also more versatile in that it can be easily transported and detonated on the ground or can be carried aloft by small balloons, aircraft or rockets cfor detonation in the air. Another advantage of the fuse is that its ice-nucleating material content being known, the amount of ice-nucleating material to be released in the atmosphere is simply determined and controlled by the length of fuse detonated.

The fuse can be detonated by ordinary means, viz by safety fuse and blasting cap or by electric blasting cap. It can also be initiated by a time tuse when carried by a balloon provided that the rate of ascent of the balloon is known.

When the nature of the ice-nuoleating material is such as to sensitize the high explosive which constitutes the core of the fuse, as is the case of silver iodide with pentaerythritol tetranitrate, a desensitizer such as glycerol must be incorporated with the explosive for safety purposes.

The invention will be more fully illustrated by the following example which is not intended to limit its scope in any way.

EXAMPLE Samples of detonating fuse containing various proportions of silver iodide (Agl) in their glycerol-desensitized pentaerythritol tetranitrate (PETN) core were detonated in a test hut having a capacity of 300 cubic feet (85x10 00.). The resulting smoke cloud was then sampled with a 100 cc. glass syringe and the syringe sample was injected into a cold chamber having a capacity of 2000 cc. maintained at temperatures of from 8.5 C. to -19 C. The number of ice crystals produced in the chamber by the silver iodide particles was estimated visually with a 300 watt projector light source and the total number of silver iodide particles produced in the hut established by the following formula:

Total AgI part1cles=N 100 where N is the number of crystals produced in the cold chamber by the syringe sample.

The results are given in the following table.

4 TABLE Fuse core in Total AgI partigrains/foot Cold chamber cles produced per temperature gram of Ag]: in AgI PETN C.) fuse core 5.0 12 1. 3X10 5.0 45 -13 1. 3X10 5.0 45 ---13 2. 0X10 5. 0 45 13 3. 6X10 5.0 45 -13 2X10 10. 0 8. 5 3. 2X10 10. 0 50 8. 5 8. 5x10 10.0 50 12 8.5 10 10. 0 50 12 1.7)(19 10.0 50 12 5.1X10 10. 0 50 12 1. 3X10 10. 0 50 15 8. 5X10 10. 0 50 15 1.7X10 10. 0 50 17 1.7)(10 It is seen from the above table that the amount of silver iodide particles produced per gram of silver iodide in the fuse core decreases with the increasing ratio of silver iodide to pentaerythritol tetranitrate in the core.

What I claim is:

l. A device for generating crystals of ice-nucleating materials for introduction of the same into supercooled atmospheric clouds which comprises a detonating fuse which is an elongated, cord-like material having a core of desensitized pentaerythri-tol tetranitrate and a protective sheath about said core, said core also containing from about 3.5% to about 20% by weight of silver iodide.

2. A device as claimed in claim 1 wherein the silver iodide is present in the core in a concentnation of from about 4.0% to about 17% by weight.

3. A process for generating crystals of ice-nucleating materials for introduction of the same into supercooled atmospheric clouds which comprises detonating contiguously to the clouds a detonating fuse which is an elongated, cord-like material having a core of desensitized pentaerytbritol tetranitrate and a protective sheath about said core, said core also containing from about 3.5% to about 20% by weight of silver iodide.

4. A process as claimed in claim 3 wherein the silver iodide in the fuse core is present in a concentration of from about 4.0% to about 17% by weight.

PATENT CITATIONS

Cited Patent	Filing date	Publication date	Applicant	Title
US2257360 *	Feb 8, 1940	Sep 30, 1941	Trojan Powder Co	Desensitized pentaerythritol tetranitrate explosive
FR1010878A *				*Title not available*

* Cited by examiner

REFERENCED BY

Citing Patent	Filing date	Publication date	Applicant	Title
US3272434 *	Jun 3, 1963	Sep 13, 1966	Chessick John J	Nucleating process
US3375148 *	Jan 17, 1967	Mar 26, 1968	Navy Usa	Pyrotechnics comprising silver iodate, ammonium nitrate, nitrocellulose and nitrate esters
US3441214 *	Jan 9, 1967	Apr 29, 1969	Weather Eng Corp Of Canada Ltd	Method and apparatus for seeding clouds
US3567117 *	Aug 29, 1969	Mar 2, 1971	Hedco	Ice nuclei formation
US3703991 *	Jul 23, 1971	Nov 28, 1972	Hedco	Snow precipitator
US3877642 *	Aug 9, 1974	Apr 15, 1975	Us Navy	Freezing nucleant
US3915379 *	Mar 22, 1971	Oct 28, 1975	Us Navy	Method of controlling weather
US4191125 *	Jul 3, 1978	Mar 4, 1980	Akzona Incorporated	Freeze indicator
US5174498 *	Jan 15, 1991	Dec 29, 1992	Yeda Research And Development Co. Ltd.	Cloud seeding
US5357865 *	Feb 21, 1992	Oct 25, 1994	Water Research Commission	Method of cloud seeding
US5441200 *	Aug 20, 1993	Aug 15, 1995	Rovella, Ii; Ernest J.	Tropical cyclone disruption
US7290722	Dec 15, 2004	Nov 6, 2007	Snow Machines, Inc.	Method and apparatus for making snow
WO1994008096A1 *	Sep 30, 1993	Apr 14, 1994	Johans Hamarsnes	A system for dissipation or dispelling of fog

* Cited by examiner

CLASSIFICATIONS

U.S. Classification	239/2.1, 239/14.1, 516/2, 149/117
International Classification	A01G15/00
Cooperative Classification	Y10S149/117, A01G15/00
European Classification	A01G15/00