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METHOD OF DISCHARGING CARBON DIOXIDE TO INHIBIT THE GENERATION OF ELECTROSTATIC CHARGES

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This invention relates to a method of discharging carbon dioxide stored under pressure, and, more particularly, to minimizing or eliminating the generation of static electricity upon the discharge of the carbon dioxide.

Carbon dioxide stored under pressure in liquid and/or gaseous state is widely used as a fire extinguishing medium by discharging the same through a snow forming shield or horn for directing carbon dioxide on the fire. One of such uses is in connection with portable fire extinguishers adapted to be carried by the operator to the location of the fire. Such extinguishers generally comprise a container having a discharge control valve and a snow forming horn connected to the outlet of the valve. The fluid carbon dioxide enters the horn through a nozzle or orifice at a high velocity and is expanded to produce a stream of carbon dioxide gas and snow in admixture, the horn serving to reduce the velocity of the carbon dioxide stream discharged from the mouth thereof whereby substantial entrainment of air is prevented. An example of such an extinguisher is illustrated in United States Patent No. 1,760,274, issued May 27, 1930.

In many instances upon discharging the carbon dioxide stored in a portable extinguisher, the operator receives an electric shock due to the generation of static electricity believed to be caused primarily by the violent collision of carbon dioxide snow particles against each other and the inner walls of the horn.

Accordingly, an object of the present invention is to overcome the foregoing difficulties and objections by providing a method of expanding and discharging fluid carbon dioxide through a horn or shield which will prevent the generation of substantial electrostatic charges.

Another object is to discharge an expanding stream of carbon dioxide gas and snow particles together with an electrostatic charge generating inhibitor.

Other and further objects will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

These objects generally are accomplished by dissolving or dispersing materials in fluid carbon dioxide under pressure in sufficient quantity to produce a lubricating effect on the particles of carbon dioxide snow formed in expanding the fluid carbon dioxide whereby to substantially eliminate or greatly minimize the generation of static electricity when the snow particles collide with each other or against a horn or shield.

In accordance with the invention, it has been found that the following additive materials or mixtures thereof may be successfully employed:

1. Kerosene, preferably of the odorless type such as sold under the trade name of "Deo-Base" by L. Sonneborn Sons, Inc., which is a practically odorless, light hydrocarbon distillate.

2. Aviation and refrigeration type lubricating oils, such as oils sold under the trade names of "General Electric D50 F50," "Gulf Oil 501" and "Esso Indiana #11699," which are highly refined lubricating oils derived from petroleum.

3. "Solvesso," a product prepared synthetically from petroleum containing chiefly aromatic hydrocarbons, for example, the several types disclosed in Lubetext, published by Esso, Inc., 1940.

These materials are fluids having a low surface tension and the tendency to spread over the horn or shield surface to form a persistent frictionless film even at extremely low temperatures, for example at —135° F., which temperature is within the usual temperature range of an expanding stream of carbon dioxide comprising a mixture of snow particles, liquid and gas. Furthermore, these materials are readily soluble or dispersible in liquid and/or gaseous carbon dioxide and are capable of existing in readily flowable state at temperatures of —5° F. and lower. The approximate pour point temperatures of these materials are:

1. Kerosene —40° to —50° F.
2. Aviation and refrigeration type lubricating oils —5° to —20° F.
3. "Solvesso" below —50° F.

It will be understood that numerous other materials not set forth specifically herein but having the aforementioned physical properties could likewise be used to accomplish the advantages of the present invention.

The carbon dioxide used in providing the composition in accordance with the invention may be of the commercial grade available in liquid state or in solid blocks of so called Dry Ice adapted to be converted into liquid state. It is possible that commercial grades of carbon dioxide may contain slight traces of impurities which are introduced in conducting fluid carbon dioxide through lubricated pipe joints or machinery parts and/or by storing the carbon dioxide in metallic containers treated with corrosion inhibiting compounds. Blocks of Dry Ice further may contain minute quantities of materials intended to promote or improve crystal growth or to serve as a plasticizer in forming the blocks. In so far as could be determined, the amount of such impurities and/or additives never exceeds .15% by weight and usually is on the order of approximately .05% by weight.

It has been found that a minium of about .1% to .75% by weight of the additive materials in accordance with the present invention, singly or in admixture, is required to be added to such carbon dioxide to provide the desired lubricating effect on the particles of carbon dioxide snow and the horn or shield to reduce friction and substantially eliminate or greatly minimize static electricity so that it is not perceptible to the operator upon discharging a fire extinguisher under conditions which heretofore would have resulted in perceptible and objectionable shocks.

The minimum amount of lubricating material selected usually depends upon the percentage of impurities or other additives already present in the carbon dioxide which is to be treated to inhibit the generation of static electricity. For example, untreated carbon dioxide which contains .15% by weight of such materials requires the addition of about .1% to .2% by weight of a material in accordance with the invention. On the other hand, untreated carbon dioxide which does not contain such materials requires the addition of at least about .2% of a material in accordance with the invention. In any case, to effectively inhibit the generation of static electricity, the treated carbon dioxide composition should contain a minimum of between .2% to .35% by weight of the additive material.

By using such percentages of material or mixtures thereof, the carbon dioxide is not contaminated to any undesirable extent and may be kept within the purity standard of 99.5% specified for carbon dioxide by the

United States Army Air Corps and other branches of the armed services. Also, by using relatively small quantities of materials or mixtures thereof, inflammable materials may be employed without danger of explosion and without adversely affecting the fire extinguishing efficiency of the carbon dioxide.

For example, liquid carbon dioxide having a purity between about 99.8% and 99.9% is commercially available, thus permitting the materials to be added thereto in amounts of from .3% to .4% by weight and still maintaining the purity of the carbon dioxide at about 99.5%.

The maximum quantity of these additive materials which can be used to inhibit the generation of static electricity does not appear to be critical, it being conceivable that any composition containing a major amount by weight of carbon dioxide and a minor amount by weight of oily material of the character specified herein can be expanded in a manner to substantially eliminate or greatly minimize static electricity. However, from a practical consideration based on the fact that the composition in accordance with the invention is primarily intended for use as a fire extinguishing medium, it is desirable not to adulterate the carbon dioxide to a point where it loses its fire extinguishing efficiency by maintaining the additive material content at a low value. In this respect, preliminary tests indicated that 5% by weight of these additive materials was permissible from a fire extinguishing viewpoint, but that preferably the quantity of such materials should not exceed about 1.6% by weight.

The present invention may thus be characterized in that the composition comprises a major quantity of carbon dioxide and a minor quantity of additive material present in an amount of at least .2% to .35% by weight of the composition and not exceeding 5% by weight but preferably not exceeding about 1.6% by weight.

In establishing the practical application of the present invention, the amounts of the materials set forth in the table were injected under pressure into about 15 pounds of commercial grade liquid carbon dioxide stored at about 850 pounds per square inch in a container equipped with a discharge valve, a syphon tube, a snow forming horn and a hose connecting the valve and the horn to provide a portable carbon dioxide fire extinguisher of the usual type as referred to hereinbefore.

Table

Example	Additive Material	Percent by Weight	Potential, kv.
1	Kerosene (commercial grade)	.35	2.0
2	do	.70	0
3	do	.85	2.0
4	do	1.05	0
5	do	1.20	0
6	do	1.45	1.0
7	do	1.55	1.0
8	Kerosene (Deo-Base type)	.30	1.0
9	do	.40	1.0
10	do	.60	.2
11	do	1.20	1.0
12	do	1.55	1.0
13	GE-D50 F50	.20	1.0
14	GE-D50 F50	.30	1.0
15	GE-D50 F50	.40	2.0
16	GE-D50 F50	.60	2.0
17	GE-D50 F50	.80	2.0
18	Esso Indiana 11699	.20	2.0
19	Gulf Oil 501	.30	.2
20	Solvesso	.20	2.0
21	do	.30	3.0
22	do	.60	2.0
23	do	1.15	2.0
24	do	1.54	4.0
25	50% Kerosene (commercial grade) + 50% Esso Indiana 11699	.20	2.0
26	85% Kerosene (Deo-Base type) + 15% Esso Indiana 11699	.30	1.0
27	do	.40	1.0
28	do	.60	1.0
29	do	.80	1.0
30	do	1.15	2.0
31	do	1.50	2.0
32	90% Kerosene (Deo-Base type) + 10% Esso Indiana 11699	.20	.4
33	do	.30	.2
34	do	.40	1.0
35	do	.60	.8
36	do	.80	.8
37	do	1.20	1.0
38	do	1.50	2.0

The carbon dioxide compositions in accordance with Examples 1 to 38 were expanded from the nozzle and discharged through the horn by fully opening the valve, and such discharge required about 28 seconds, the discharge rate being about .5 pounds per second. The electrostatic charge and its potential were determined by the use of an electrostatic voltmeter and a microammeter, and it was found that in all cases the total electrostatic charge developed was not more than about 10 microcoulombs at a potential of between about 0 and 4.0 kilo-volts (kv.), the average potential being 1.3 kv.

Ten fire extinguishers of like construction and capacity containing 15 pounds of commercial grade liquid carbon dioxide, which was not treated in accordance with the present invention, were likewise discharged under the same temperature and humidity conditions, and it was found that the average total electrostatic charge developed was on the order of 500 microcoulombs at about 35 kv., thereby clearly establishing that the present invention greatly minimizes or practically eliminates the generation of electrostatic charges. In spite of the fact that the untreated carbon dioxide contained slight traces of the usual impurities and/or materials to promote or improve crystal growth or to act on a plasticizer in forming blocks of Dry Ice, these materials had no noticeable effect in inhibiting the generation of static electricity, probably because they were present in insufficient amounts.

While it is not intended to limit the invention to any particular theory, it is believed that the materials or mixtures used herein provide a lubricating film on the surface of the snow particles formed and thereby greatly reduce friction upon collision of the particles against each other and the inner wall of the horn.

It is also contemplated that the materials may be added to the stream of carbon dioxide during its flow from the container to the discharge horn.

From the foregoing description, it will be seen that the present invention provides for substantially eliminating or greatly minimizing the generation of electrostatic charges upon discharging carbon dioxide through a snow forming horn in a novel manner. The inhibitors do not materially increase the cost of the carbon dioxide, do not adversely affect the fire extinguishing properties of the carbon dioxide, can be injected into the carbon dioxide in a simple manner, and are effective upon discharging the carbon dioxide at relatively high rates under conditions of low temperature and low relative humidity.

As various changes may be made without departing from the scope and spirit of the invention, it will be understood that the details and examples hereinbefore set forth are illustrative only and that the invention as broadly described and claimed is in no way limited thereby.

This application is a continuation-in-part of application for United States Letters Patent, Serial No. 677,511, filed June 18, 1946, now abandoned.

I claim:

1. The method of discharging a charge of fluid carbon dioxide composition confined in a container under pressure from a nozzle through a shield to form carbon dioxide snow particles, which method comprises introducing into the carbon dioxide between at least about .2% but not exceeding 5% by weight of the composition of an oily hydrocarbon material having a low surface tension and being capable of existing in readily flowable state at a temperature of −5° F. and being capable of retaining its oily characteristics at a temperature of −135° F., and directing the carbon dioxide and the oily material in admixture therewith through the nozzle to form carbon dioxide snow particles in the shield whereby the snow particles and the interior of the shield are coated with the oily material to form a persistent frictionless film on the interior of the shield adapted to inhibit the gen-

eration of electrostatic charges upon the flow of snow particles through the shield.

2. The method of discharging a charge of fluid carbon dioxide composition confined in a container under pressure from a nozzle through a shield to form carbon dioxide snow particles, the carbon dioxide having introduced therein in between at least about .2% but not exceeding 5% by weight of the composition of an oily hydrocarbon material having a low surface tension and being capable of existing in readily flowable state at a temperature at —5° F. and being capable of retaining its oily characteristics at a temperature of —135° F., which method comprises directing the carbon dioxide and the oily material in admixture therewith through the orifice to form carbon dioxide snow particles in the shield whereby the snow particles and the interior of the shield are coated with the oily material to form a persistent frictionless film on the interior of the shield adapted to inhibit the generation of electrostatic charges upon the flow of snow particles through the shield.

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