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SOLIDIFIED PARAFFIN WAX OR LITHIUM METAL MATRIX WITH METAL HYDRIDE DISPERSED THEREIN AND PREPARATION

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ABSTRACT OF THE DISCLOSURE

An incendiary composition comprising a gelled normally solid but meltable fuel, finally divided solid fuel partices uniformly dispersed therein, with said finely divided solid fuel particles having a heat of combustion of greater than 5.0 Kcal./ml. and a gelling agent incorporated into said meltable solid.

The present invention is directed to incendiary compositions, and more particularly, to incendiary compositions useful in distress signals, and for distress fires.

There are many situations in which foolproof incendiary means are needed, which must fit into a confined space. By way of example, aviators, campers, hunters, and other outdoorsmen frequently carry emergency survival kits which provide a small space for matches in a screw-on- or clamped-lid box. Space for such items is at a premium. The demands of such incendiary means for a survival kit are multifold, and include the absolute necessity for safe carriage of the incendiary compositions in the user's pockets, relative freedom from attack on the incendiary compositions from water, and the ability to start a number of survival fires (often under difficult weather conditions) from a minimum volume of the composition.

Other devices used in survival fire-starting include butane lighters with flint wheel igniters. One such lighter holds about 0.2 ounce (fluid) of butane and occupies a volume approximately three times that of the butane fuel, and is estimated to yield only 1.2 Kcal. per milliliter of occupied volume.

This invention has an object the provision of incendiary compositions to be used in emergency survival kits, and the like, in which the fire-starting capability is greatly increased over incendiary compositions used in existing devices.

This invention has as another object the provision of an incendiary composition which may be conveniently packaged and carried about safely.

This invention has as still another object the provision of an incendiary composition which may be self-igniting.

This invention has as an object the provision of an incendiary composition which will readily set fire to adjacent wood and other combustible materials.

Other objects will appear hereinafter.

The aforesaid objects are accomplished by the incendiary compositions of the present invention which comprise gelled slurries containing from 30 to 75 volume percent of finely divided solid fuels having a heat of combustion of greater than 9.0 Kcal./ml. uniformly disposed in a gelled meltable solid fuel.

The finely divided solid fuels should be powders having a particle size range of the order of up to about 50 microns maximum dimension. As a practical matter, the minimum size particles which can be used in the solid fuels of the present invention may be well below one micron maximum dimension. The limiting factor in minimum particle size will be ease of handling.

The preferred solid fuel consists of finely divided metal powders whose heat of combustion exceeds 9.0 Kcal./ml., such as fine boron, aluminum, zirconium, and magnesium. Lithium may also be incorporated as a finely divided solid for enhanced combustion. However, finely divided solid fuels consisting of compounds such as metal hydrides may be used.

Meltable solid fuels, such as paraffin wax or lithium metal can be used in the present invention provided that they are gelled while in the liquid state.

The compositions of the present invention include a gelling agent, which should be present in an amount sufficient to effect gelling of all of the liquid present in the composition. The gelling agent should be one which has a gelling efficiency such that no more than about 5 weight percent of the composition need be gelling agent. In some compositions, the finely divided powder possesses gelling characteristics, and the amount of gelling agent which need be present in such compositions may be reduced. Generally, at least about one-half weight percent of gelling agent must be present to achieve satisfactory gelling of the liquid portion of the composition. A satisfactory gelling agent is the pyrogenic silica designated "Cab-O-Sil H5" and sold by Godfrey L. Cabot, Inc., of Boston, Massachusetts.

Examples of gelling agents include: pyrogenic silica, namely finely divided silica particles derived from the combustion of silicon tetrachloride, such materials being commercially available as gelling agents under the trademark "Cab-O-Sil"; carbon black having a clean microsurface and a high degree of structure with said structure being internal with particles smaller than 25 millimicrons as measured by an electron microscope and presenting a ratio of BET surface as determined by nitrogen adsorption measurement to electron microscope surface of between 2½ and 6 and with larger particles being external, namely possessing persistent reticulate chain formation observable in the electron microscope after mulling by the procedure of Ladd [1]; pyrogenic aluminum oxide derived from the combustion of aluminum trichloride; carboxymethyl cellulose, sulphonated polyvinyl toluene; carogeenin, and guar, etc. A suitable pyrogenic alumina is available under the trade name "Alon C."

By "gelled liquid" as used herein is meant a material possessing a yield stress sufficiently high to prevent flow under low forces such as gravitation, namely a yield stress of 200 dynes per square centimeter, is adequate.

In some situations the addition of a surfactant, as in the concentration of 0.1 to 1 weight percent based on the amount of gelled liquid present is helpful. Examples of suitable surfactants include: sorbitan trioleate; polyethylene glycol ether of hydroabietyl alcohol; polyoxyethylene sorbitan monooleate diethylene glycol laurate sulfonated castor oil triethanolamine monooleate.

The presence of the surfactant improves wetting of the finely divided powders and increases flowability.

The function of the gelled liquid is to keep the particles making up the finely divided powder from each other so that they do not adhere to each other, as by sintering or by Van der Waals attraction.

The incendiary compositions of the present invention may be stored and used in a variety of containers. With those compositions which are self-ignitable, such as those which include triethylaluminum, or bromine pentafluoride, no means need be provided for igniting the composition.

Where ignition of the composition is necessary, the

[1] Rubber Age, vol. 57, June 1945, p. 299.

composition may be dispensed through a conventional lighter provided with a flint wheel. Alternatively, the composition may be dispensed from a collapsible container through a nozzle onto a surface and then ignited by matches, or the like.

The ignitability and self-ignition, as well as the burning rate, fluidity, and other physical properties of the incendiary compositions of the present invention can be regulated to some degree by controlling the particle size. This may require in many instances some routine testing within the skill of one having skill in this art.

A particular incendiary composition to be used for a given purpose will vary depending upon the purpose. Those compositions which are pyrophoric or self-igniting have the advantage of eliminating the need for matches and other igniters, but are more hazardous.

The use of metal powders is preferred because we have determined that in addition to producing intense heat, such powders also produce a hot slag which helps transport the heat to a target, such as a substrate of wood. The advantage of the hot metal slag is that unlike heated gases, the hot metal slag localizes the heat within an area, without the heat being dissipated as in the case of hot gases which are blown away.

In those embodiments of the present invention in which a meltable fuel is used, such as paraffin wax, the incendiary composition can be cast into a desired shape, such as into sticks. When the incendiary composition is ignited, the composition will melt before the flame front. However, the melted paraffin will not leak away, as in the case of conventional candles, because it is gelled.

The following example illustrates a composition of the present invention. It is to be taken as illustrative, and is not to be deemed limiting the scope of the present invention.

EXAMPLE

	Percent by volume
Aluminum powder	45
Paraffin wax	54
Pyrogenic silica	1

We claim:

1. A method for forming an incendiary composition which comprises adding a gelling agent to a meltable normally solid fuel selected from the group consisting of paraffin wax and lithium metal while such meltable normally solid fuel is in its molten state whereby said molten fuel is gelled, uniformly dispersing within said gelled molten fuel from 30 to 75 volume percent of the finely divided solid fuel having a higher melting point than said meltable normally solid fuel and a heat of combustion of greater than 5.0 Kcal./ml. at a temperature below the melting point of the finely divided solid fuel, said finely divided solid fuel being selected from the group consisting of metals and metal hydrides, and then solidifying said mixture.

2. A method in accordance with claim 1 in which the finely divided solid fuel is a pyrophor.

3. A cast shape formed from incendiary composition prepared in accordance with the method of claim 1.

4. A cast shape formed from incendiary composition prepared in accordance with the method of claim 2.

References Cited

UNITED STATES PATENTS

Re. 25,277	10/1962	Toulmin	149—87 X
2,938,779	5/1960	Kolfenbach et al.	149—87 X
2,960,394	11/1960	Schrieber et al.	149—87 X
2,968,917	1/1961	Whaley	149—87 X
3,035,948	5/1962	Fox	149—87 X
3,243,326	3/1966	White et al.	149—87 X
1,035,202	8/1912	Lang	149—17
3,133,841	5/1964	Kvehl	149—17 X
3,158,993	12/1964	Hodgson	149—17 X
3,158,994	12/1964	Hodgson	149—17 X
3,191,535	6/1965	Mulloy	149—17 X
3,325,316	6/1967	MacDonald	149—17

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