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MEANS FOR PREVENTING ICING IN JET FUELS

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This invention relates as indicated to means for preventing icing in jet engine fuels and has particular reference to the use of certain organo-boron compounds.

The fuel used in present day jet engines comprises a crude kerosene product known to those skilled in the art as "JP-4." This material while satisfactory as a fuel, allows for a certain degree of water solubility. As much as 100 parts per million of water can dissolve in this fuel. During cold weather or at high altitudes the water in the fuel crystallizes and the subsequent ice formation clogs the fuel line and causes engine failure.

It is therefore the principal object of this invention to provide a means which prevents jet engine fuel from icing.

Other objects will appear as the description proceeds.

To the accomplishment of the foregoing and related ends the invention then comprises the features hereinafter fully described and pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few ways in which the principle of the invention may be employed.

Broadly stated, the present invention comprises as a new composition jet engine fuel and an anti-icing additive, said additive comprising from about 0.01% to about 1.0% by weight of a material selected from the group consisting of water unstable esters of boric acid, benzeneboronic acids, alkane boronic acids, diphenyl borinic acids, and dialkyl borinic acids in which the esters are derived from alcohols having from 1 to 12 carbon atoms; water unstable bborates of 1,2- and 1,3-glycols; and water unstable boric anhydrides of 1,2- and 1,3-glycols.

It is important to note here that all of the materials enumerated in the foregoing broadly stated paragraph are water unstable. In other words, the material to be applicable as an anti-icing additive in the present invention must be readily hydrolyzable.

It is our theory that the present additives are efficient anti-icing agents principally for two reasons: (1) the present materials are soluble in the jet fuel, and (2) they all undergo hydrolysis readily. The water in the fuel hydrolyzes the anti-icing agent and thus is not available to cause ice formation in the fuel. However, whether our theory is correct or not, the fact remains that the additive to be operable must be a water unstable compound selected from the group disclosed in the foregoing broadly stated paragraph.

The following list is illustrative of the anti-icing additives applicable to the present invention:

Tri-(hexylene glycol) bborate
Di-(hexylene glycol) boric anhydride
Di-(glyceryl monooleate) boric anhydride
Tri-(glyceryl monooleate) bborate
Tri-2-ethylhexyl borate
Triethyl borate
Tri-n-propyl borate

Tridodecyl borate
Diisopropyl benzeneboronate
Dioctyl benzeneboronate
Diethyl butaneboronate
Dibutyl n-decaneboronate
Isopropyl diphenylborinate
n-Hexyl diphenylborinate
Amyl dioctylborinate
Nonyl dipropylborinate

While the foregoing enumerated compounds comprise only a representative list of the materials applicable to the present invention, it will be understood that any compound which is a water unstable ester of boric acid, benzeneboronic acids, alkane boronic acids, diphenyl borinic acids and dialkyl borinic acids in which the esters are derived from alcohols having from 1 to 12 carbon atoms; water unstable bborates of 1,2- and 1,3-glycols; and water unstable boric anhydrides of 1,2- and 1,3-glycols is equally usable in the present invention as an anti-icing additive.

We have found that the addition of from about 0.01% to about 1.0% by weight of the above-mentioned additives based on the weight of the jet fuel will prevent icing of the fuel down to the freezing temperature of the fuel itself.

The present additive is extremely simple to use. All that is required is thorough admixture with the jet engine fuel. The need for any special processing or equipment is eliminated, and further our anti-icing agent being used in such small amounts is extremely economical.

Thus for example 0.1% by weight of triethyl borate when admixed with jet engine fuel will prevent ice-formation in the fuel to a temperature of -60°C .

Other modes of applying the principle of the invention may be employed provided the features stated in any of the following claims or the equivalent of such be employed.

We, therefore, particularly point out and claim as our invention:

1. The method of preventing icing in kerosene jet engine fuel which consists essentially of adding to said kerosene fuel from about 0.01% to about 1.0% by weight of an anti-icing additive selected from the class consisting of water unstable esters of boric acid, benzeneboronic acids, alkane boronic acids, diphenyl borinic acids and dialkyl borinic acids in which the esters are derived from alcohols having from 1 to 12 carbon atoms; water unstable bborates of 1,2- and 1,3-glycols; and water unstable boric anhydrides of 1,2- and 1,3-glycols.

2. The method of claim 1 wherein said anti-icing additive is tri(hexylene glycol)bborate.

3. The method of claim 1 wherein said anti-icing additive is di(hexylene glycol) boric anhydride.

4. The method of claim 1 wherein said anti-icing additive is tri-2-ethylhexyl borate.

5. The method of claim 1 wherein said anti-icing additive is triethyl borate.

6. The method of claim 1 wherein said anti-icing additive is diisopropyl benzeneboronate.

References Cited in the file of this patent

UNITED STATES PATENTS

65	2,151,432	Lyons et al. -----	Mar. 21, 1939
	2,720,448	Arimoto -----	Oct. 11, 1955
	2,720,449	Arimoto -----	Oct. 11, 1955
	2,741,548	Darling et al. -----	Apr. 10, 1956
	2,767,069	Fay et al. -----	Oct. 16, 1956
70	2,875,236	Levens et al. -----	Feb. 24, 1959