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2,958,591

GASOLINE CONTAINING DIMETHYL FORM-AMIDE AND BORON COMPOUND AS ANTI-ICING ADDITIVE

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2 Claims. (Cl. 44—63)

This invention relates to a motor fuel composition adapted to minimize carburetor icing in automotive engines in cool, moist, atmospheric conditions. In particular, this invention relates to a hydrocarbon fuel having the volatility characteristics of a commercial gasoline for use in normal engine operation containing in small percentage an admixture of dimethylformamide and a glycol borate as hereinafter described. It is intended that the hydrocarbon fuel may contain tetraethyl lead and any other additives commonly employed for commercial motor fuels, such as oxidation inhibitors, gum inhibitors, solvents, dyes and the like.

For years, the average motorist has been annoyed with operational difficulty of automobile engines under idling conditions characterized by frequent stalling when operating the engine in weather conditions where the combination of high humidity and temperatures lower than 60° F. are present.

In recent years this annoyance has been aggravated by certain mechanical innovations to modern engines and the need of these engines for more volatile motor fuels. Consequently, the complaint of such stalling difficulty is quite general today and seems to be experienced in all types of cars using all types of carburetors and utilizing all commercial grades of gasolines.

A thorough study of this problem indicates that the cause of this stalling effect is due to the formation of ice in the carburetor of the engine. Vaporization of the gasoline in the carburetor produces temperature reduction in the metal parts of the carburetor considerably below that of the incoming air which on cool and humid days causes the moisture in the air to condense and freeze. Ice formation on the throttle plate and walls of the carburetor results, and after a short while the ice build-up restricts the narrow air openings in the carburetor causing the engine to stall. This condition is most likely to occur during engine warm up when the engine is below its normal operating temperature but is experienced commonly during other periods of light load operation, such as when the engine is idling.

It is therefore the object of the motor fuel composition of this invention to alleviate the operational difficulties previously discussed in the gasoline engine caused by carburetor icing.

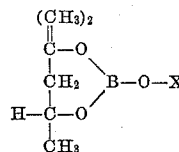
In accordance with this invention, it has been found that the combined effects of dimethylformamide and a boron compound from a class hereinafter described demonstrate a synergy in regard to anti-icing, overcoming in great part the operating difficulties consequent to carburetor icing.

Patent No. 2,706,677 discloses classes of high-boiling amines and amides which are effective anti-icers when employed in a concentration range from about 0.2% to 0.5% by volume based upon the volume of gasoline present. Included among the compounds disclosed is one of the ingredients of this invention, dimethyl formamide.

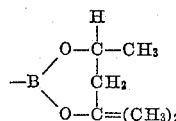
Patent No. 2,741,548, granted to our associates and assigned to our assignee, discloses gasolines containing

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organic compounds of boron which are effective in modifying the actions of these fuels in internal combustion engines. Included in the compounds described in this patent are those having the following formula:



where X=H or



The surprising and unexpected finding of this invention is that the addition of relatively small amounts of dimethylformamide to the boron-containing motor fuel coacts with the boron compound present to provide effective prevention of carburetor icing. The effect demonstrated by the coaction is significantly higher than what would be expected from the two compounds independently in gasolines. The amount of the dimethylformamide may range from 0.01 to 0.1% and the amount of the hexylene glycol borate may range from 0.025 to 0.1%.

An important auxiliary benefit is also realized by the use of this combination in motor fuel. The boron compounds previously described as a gasoline additive must normally be diluted with a suitable solvent in order to stabilize the boron composition in a liquid phase for blending into gasoline and to control the viscosity of the composition in a range so that it is easy to pump and meter during the blending-in operation. The dimethylformamide in the amounts required by this invention can effectively serve as such a solvent by stabilizing the composition and reducing the viscosity of the composition, thereby eliminating the need for a conventional solvent such as toluene. In addition to the direct savings in the use of a solvent, this procedure simplifies plant operation by avoiding the special handling and storage of such a solvent.

A more complete understanding of the effectiveness of the combination of the compounds of the invention in preventing carburetor icing may be appreciated from the following working example conducted in a laboratory testing apparatus. This apparatus was constructed to closely simulate the actual performance of an automotive engine carburetor wherein the apparatus was equipped to measure the time that ice would form when testing various motor fuels. In all the test runs from which the data below was obtained the apparatus was operated with consistent laboratory technique and under identical control means and with the same fuel as described hereinafter. Reproducibility of results on identical fuels with this test apparatus has been shown to be experimentally acceptable.

The apparatus was constructed so that controlled amounts of humid air and fuel are mixed and led into a carburetor. The carburetor itself is equipped with a glass sight part so that visual observation of the throttle plate during the run is possible. A temperature measuring means is connected to the throttle plate so that the plate temperature can be measured. In running a test with this apparatus, air flow is started through a cooling system to the carburetor. The cooling system is controlled so that the air entering the carburetor is at 40° F. and saturated with moisture. At this point, the temperature of the throttle plate is measured. If the plate temperature is above 40° F., some fuel is allowed to flow through

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the plate to cool it below 40° F. The fuel flow is then stopped and the plate temperature is allowed to reach 40° F., the same temperature of the saturated air. The fuel flow is then started at a controlled rate, and zero time is taken as the time of starting the fuel. The throttle plate temperature begins to drop quickly and this change is followed. Visual observations are made on the throttle plate, and the time of ice formation on the plate can be readily observed. In order to achieve another method of determining the end point in this test procedure, a pressure system was connected to the cooling system which would readily detect any pressure increase in the air flow. Such a pressure increase is caused by the blocking of the passage of air by the ice around the rim of the throttle plate. The pressure increase occurring during ice formation on the throttle plate is abrupt and serves as a more accurate and reliable method of determining the end point of the icing test than visual observation. Consequently, the time to ice in minutes for the runs reported in the table below were determined by observing this rise in air flow pressure.

The reference fuel used in all test runs below was a hydrocarbon blend of 36.2% naphtha, 63.8% catalytic distillate, and 0.2% of a solvent oil, i.e., a neutral oil having a viscosity of 64.6 SSU at 100° F. The fuel had the following distillation characteristics:

Initial boiling point	° F.	106
20% off at	° F.	132
40% off at	° F.	154
60% off at	° F.	198
80% off at	° F.	298
90% off at	° F.	365
End point	° F.	412
Reid vapor pressure	p.s.i.	9.6

Reference Fuel Plus Additive	Additive Conc. in Wt. Percent of Total Fuel	Time to Ice (min.)	Improvement Over Reference Fuel
None	0	4.47	0
DMF	0.025	5.67	1.20
Boron Compound	0.05	9.23	4.76
DMF+Boron Compound	0.025 DMF; 0.05 Boron Compound	24.15	19.68

The boron composition in the above example was an admixture of 25% 2-methyl pentanediol-2,4 hydrogen borate and 75% bis-(2-methyl pentanediol-2,4) diborate.

As may be readily seen from the table above, the boron compound and dimethylformamide coact significant-

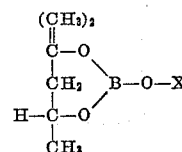
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ly in preventing ice formation. The expected improvement in the above example by adding the independent effects of the additives would be 5.96 compared to 19.68 actually observed.

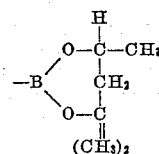
The invention disclosed herein is intended to be limited in scope only by the claims appended hereto.

We claim:

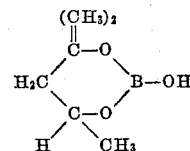
1. A motor gasoline to which has been added 0.01 to 0.1% by weight dimethylformamide and 0.025 to 0.1% by weight of a boron compound having the following formula:



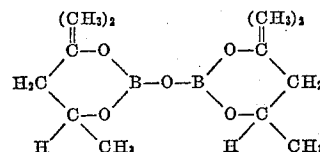
where X is selected from the group consisting of hydrogen and



2. A motor gasoline to which has been added 0.025% by weight dimethylformamide and 0.05% by weight a boron reaction mixture consisting of an admixture of about 25% the compound of the formula:



and 75% the compound of the formula:



References Cited in the file of this patent

UNITED STATES PATENTS

2,706,677	Duncan et al.	Apr. 19, 1955
2,767,069	Fay et al.	Oct. 16, 1956
2,848,312	Liao	Aug. 19, 1958