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LIQUID FUELS FOR REACTION MOTORS

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1 Claim. (Cl. 149-46)

Our invention relates to new liquid fuels for reaction motors, and more particularly, to improved methanol base fuels of improved power suitable for use in all types of fuel injection engines.

Our improved fuels, while suitable for use in all types of fuel injection engines, are particularly adaptable not only to piston-type internal combustion engines, but also to all engines which function on the jet principle such as pulse, turbo and ramjets and turboprops. The advent of aircraft of greatly increased load capacity has greatly increased the problems of getting the aircraft airborne within the limitations of the spaces normally available. This is particularly the case with the most recent jet airliners which require 10,000 feet of runway to take off on a hot day when fully loaded. Similar problems are involved in getting both fast fighter planes and heavily loaded bomber planes airborne from the limited space of aircraft carriers. Our improved fuels are especially useful in all such cases.

The basis of our improved fuels is methanol to which is added ingredients which give added thrust and other useful properties without at the same time detracting from the other advantages in the use of methanol as a fuel for injection engines. Methanol has been used previously either alone or mixed with water, in fuel injections engines, primarily to lower combustion temperatures and to provide added power. The flame temperature of methanol in air, for example, is about 200° F. below that of conventional hydrocarbon fuels. This would be expected from the fact that the B.t.u. value of methanol per pound is 8,510 as compared to 19,171 for pentane, a hydrocarbon standard. Fuels are normally rated by their B.t.u. content per pound but during take-off of an airplane, the maximum power or thrust is limited by the maximum amount of air available for combustion. For this reason, during take-off, or for very high altitude flying, fuels are more correctly rated in the terms of B.t.u.'s per pound of air.

The combination of nitromethane with methanol has previously been suggested. While such combinations give added power from fuel injection engines, such combinations have never found large commercial uses because of the relatively high cost of such compositions and also because of the fact that nitromethane has not been available commercially in large quantities.

We have now discovered that improved liquid fuels can be prepared by mixing ammonium nitrates and monomethylamine with methanol. Our improved fuels comprise from about 50 to about 85% by weight methanol, about 5 to about 30% by weight of ammonium nitrate and from about 5 to about 15% by weight of monomethylamine.

Our new improved alcohol base fuels can be conveniently and economically prepared in a number of ways. While ammonium nitrate is not soluble in methanol to the extent required for an improved impulse fuel, either a part or the entire amount of ammonium nitrate required for the latter can be added to the methanol and the required amount of monomethylamine then bubbled into the alcohol while agitating the latter. Upon the addition of the required amount of monomethylamine, all of the ammonium nitrate goes into solution and is uniformly dispersed throughout the alcohol. An alternate method consists of mixing the required amounts

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of ammonium nitrate and monomethylamine and dissolving the liquid in the required amount of the alcohol.

The fuel compositions prepared as above described have, in general, vapor pressures ranging between the vapor pressures of pure methanol and, for reference purposes, pure pentane, and having freezing points ranging from slightly below 0° F. to approximately -71° F., they are in general usable under the same conditions and in the same type of engines as those in which methanol and pentane are used.

When our improved alcohol base fuel compositions are used in air-breathing engines, such as turbojet engines, ramjet engines, diesel engines, etc., principles of operation which apply are similar to those applicable to present day engines employing ordinary hydrocarbon or alcohol fuels. In all of these engines the oxygen in the air is mixed with the fuel so that the fuel-air ratio is approximately stoichiometric. In this way complete burning and efficient operation is assured. For example, when an 82.4% methanol, 8.3% ammonium nitrate, and 9.3% monomethylamine mixture is used as a turbojet engine fuel, a weight ratio of air to fuel of at least about 6.2:1 is desired. After combustion of our fuels in the combustion chambers of a turbojet engine, additional air is bled into the exhaust gases prior to passing them through the gas turbine blades in order that the turbine blades may be maintained at a temperature of about 1500-1600° F.

To utilize the compositions of our invention, we merely flow them, at a desired rate, into a combustion chamber containing a suitable heating element, such as a white hot platinum grid or glow plug to initiate combustion. Once combustion has begun, the heating element can be removed or can remain within the reaction motor to catalyze the burning rate of the fuel.

The following table shows physical properties for a number of our compositions prepared as above described:

TABLE

	82.4% CH ₃ OH 8.3% NH ₄ NO ₃ 9.3% CH ₃ NH ₂	64% CH ₃ OH 29.5% NH ₄ NO ₃ 6.5% CH ₃ NH ₂	Pentane	Methanol
B.t.u.'s/lb. air	1,360	1,435	1,253	1,317
Freezing pt., ° F.	-63	-6.5	-202	-144
Density, 77° F.	0.821	0.916	0.621	0.793
Vapor Pressure, 77° F. mm.	190		500	124

The following examples more fully illustrate how our invention is used in various types of motors, but it is not intended that our invention be limited to the motors, specific fuels, or processes described.

Example I

To test our fuel in a turbojet engine, 295 pounds of ammonium nitrate was mixed with 65 pounds of monomethylamine and the resulting solution was then added to 640 pounds of methanol to form a high density methanol solution. This fuel was then metered into the combustors of a J-35 axial flow turbojet engine through the fuel nozzles. The fuel was metered into the combustors at a rate such that the air-fuel ratio was about 4.5:1. At this air-fuel ratio, the mixture burned well and increased thrust noticeably over the use of methanol alone in a similar experiment.

Example II

In a further experiment, a fuel mixture similar to the mixture of Example I was passed into an after-burner section of a turbojet engine with the same noticeable increase in thrust.

Example III

A solution of 75% methanol, 20% ammonium nitrate, and 5% monomethylamine was fed into a small thrust chamber up of available 1" stainless steel pipe and stainless steel pipe fittings. The fuel injection nozzle was made up from a pipe plug. An orifice diameter of 0.040" was drilled in the pipe plug and a needle valve assembly was seated in and welded onto the plug. For ease of repair, a 1" union was used to attach the nozzle to the 4" pipe which comprised the burning chamber. An oxygen inlet tube and a Bourdon-type pressure gauge with a range of 0-600 p.s.i. were attached to the burning chamber through the plug. A reducing coupling was utilized as the motor nozzle. The above-described fuel and an approximately stoichiometric amount of gaseous oxygen were introduced into the thrust chamber through the injection nozzle. Ignition was initiated by preheat-

ing the chamber to a red heat. The fuel burned well with good thrust.

Now having described our invention what we claim is:

A liquid fuel consisting essentially of from about 50 to about 85% by weight methanol, about 5 to about 30% by weight of ammonium nitrate, and from about 5 to about 15% by weight of monomethylamine.

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