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2,989,388

FUEL AND PROPELLANT COMPOSITION

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No Drawing. Filed Mar. 17, 1958, Ser. No. 721,697

2 Claims. (Cl. 52—.5)

This invention relates to improved fuels and methods of increasing the calorific value of fuels.

The invention is particularly useful in providing a fuel which is composed of powdered materials such as substances which are decomposable to release large volumes of gas heated to high temperatures.

The principal object of the invention is to provide a powdered fuel which forms a suitable burning mixture useful as propellants, missiles, rockets, power plants, etc., and which may be used as a fuel for jet-driven airplanes, turbines, and the like, as employed in the fields of aviation, rail transportation and military equipment and operations.

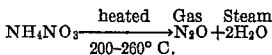
It is another object of the invention to provide a composition useful as fuel which is adapted to burn at a non-explosive rate and produce a large amount of gases.

It is a further object of the invention to provide a powdered fuel mixture which can be used in the form of a slurry or admixed with liquid hydrocarbons, and which releases a large amount of exothermic heat upon burning.

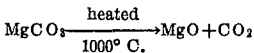
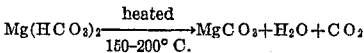
A still further object of the invention is to provide a method for carrying out the combustion of powdered fuel mixtures of the character described which supply or release a sufficient amount of oxygen to maintain the combustion of the mixture once it is initiated.

The invention provides a fuel of the character described and which comprises as the principal constituents ammonium nitrate and magnesium carbonate, which compounds decompose to release nitrous oxide, water, steam and carbon dioxide.

Ammonium nitrate when heated, as shown below, decomposes in accordance with the equation—



Magnesium when heated decomposes to release water and carbon dioxide in accordance with the following equations:



The hydrated basic carbonate $\text{Mg}(\text{OH})_2 \cdot 3\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$ may be used which decomposes at a lower temperature than the normal carbonate MgCO_3 . The large volume of gases formed during burning of the mixture provides the propellant force.

Examples of the powdered fuel are as illustrated below:

Example I

	Percent by weight
Ammonium nitrate (NH_4NO_3)	35
Magnesium bicarbonate $\text{Mg}(\text{HCO}_3)_2$	35
Cellulose nitrate	20
Metal powder (Mg, Al, Zn)	10

Example II

Ammonium nitrate (NH_4NO_3)	40
Magnesium bicarbonate $\text{Mg}(\text{HCO}_3)_2$	30
Cellulose nitrate	20
Metal powder (Mg, Al, Zn)	8
Metallic soap (aluminum stearate)	2

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Example III

Percent by weight

Ammonium nitrate (NH_4NO_3)	40
Magnesium carbonate (MgCO_3)	25
Cellulose nitrate	25
Metal powder (Al, Mg, Zn)	10

Where greater proportionate amounts of ammonium nitrate is used, for example above 50%, the mixture burns at explosive rates. Heretofore high density explosives have been made containing high ammonium nitrate content. In the present fuel mixture, the burning rate of the nitrate is dampened or lowered by the inclusion of high nitrogen content of the cellulose nitrate, also referred to herein as nitrocellulose and release of water and carbon dioxide from magnesium carbonate. The proportion of constituents thus may be varied to control the rate of burning of the mixture.

In preparing the fuel mixture, ammonium nitrate is admixed with nitrocellulose of commercial grade. Magnesium carbonate in the form of a powder (200 mesh) is then added and finally the metal powder is then admixed therein, the metal being in relatively small particle size and on the order of 10-50 microns, with particle size of 10 microns or less in diameter preferred. The mixture of ammonium nitrate, magnesium carbonate, nitrocellulose and metal powder may be suitably compressed (2000 p.s.i.) and used as a solid block fuel or used as a slurry mass by adding hydrocarbon liquids such as kerosene or an aromatic alkane in amounts from 10 to 30% by weight of the total mixture.

As an example a suitable liquid hydrocarbon which may be used has the following characteristics—

Distillation range	° C. 200-330
Specific gravity	0.75
Flash point (closed cup)	° C. 80.9

The ammonium nitrate used is of relatively high purity so as to be free of impurities such as iron, chloride and sulfate.

The nitrocellulose has a nitrogen content of at least 12% and preferably 13-15% so as to produce a readily combustible but non-hazardous material for handling.

The magnesium carbonate releases water and carbon dioxide which controls the burning rate of the mixture whereby the same will be consumed at a non-explosion rate.

In Example II, a small amount of metallic soap is incorporated with the metal powder to catalyze its oxidation. Such metallic soaps are preferably selected from the polyvalent metals consisting of aluminum, magnesium, zinc or tin. Fatty acid esters of these metals, e.g., the metal stearates, palmitates, oleates and ricinoleates and the like are employed. One readily available commercially is aluminum stearate.

This metallic soap catalyzer may range between 0.1-2% by weight of the powdered metal constituent and up to 5% by weight of the composition. The metal particles of the fuel mixture are preferably in the form of dust, flakes, or thin ribbons or strips, and the metallic soap is suitably coated on or admixed with the metal particles.

The combination of the metal particles with the ammonium nitrate, magnesium carbonate and nitrocellulose when burning releases large quantities of nitrogen, oxygen, carbon dioxide and steam which gases are heated to very high temperatures and on the order of 4000° C. or higher. The powdered metal particles alone, such as aluminum metal, burn in air at a temperature of around 3500° C. and produce an intense heat. The high temperatures produced during burning of the fuel causes rapid decomposition of the admixture and release of large volumes of gases. Vaporization of water formed dur-

ing the reaction forms steam, which is decomposed into hydrogen and oxygen.

The metals are preferably selected from the group consisting of aluminum, magnesium, zinc, tin and the like or mixtures thereof. The presence of metallic soap catalyzes the burning as aforementioned so that the same takes place at a uniform rate and yet is under sufficient control due to the release of water so that the mixture will not explode. The fuel mixture thus provides a continuing expanding gaseous force useful as a propellant or propulsion means.

The rate of combustion or burning of the fuel is varied by varying of the proportionate amounts of the constituents whereby the powdered fuel mixture is caused to burn rapidly and release the high volume of gases at high temperatures at a continuing non-explosive rate.

Ignition of the fuel mixture may be carried out by electrical means such as that produced by a spark plug or by the heating of wire to incandescence in contact with the mixture.

It is understood that various changes and additions in equivalent materials may be substituted for those set forth in the above examples when compounding the fuel of this invention and that the proportionate amounts of the constituents may be varied, as heretofore described, and depending upon the particular use to which the fuel is to be put. Such changes and variations are deemed to be contemplated to come within the spirit and scope of this invention and which are particularly set forth in the appended claims.

What is claimed is:

1. A fuel of the character described, comprising the following mixture in parts by weight—

	Percent
Ammonium nitrate -----	40
Magnesium bicarbonate -----	30
Cellulose nitrate -----	20
5 Aluminum metal particles -----	8
Aluminum stearate -----	2

2. A fuel of the character described, comprising the following mixture in parts by weight—

	Percent
10 Ammonium nitrate -----	40
Magnesium bicarbonate -----	30
Cellulose nitrate -----	20
Aluminum metal particles -----	8
15 Aluminum stearate -----	2

said aluminum metal particles being coated with said aluminum stearate.

References Cited in the file of this patent

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UNITED STATES PATENTS

1,506,322	O'Neill -----	Aug. 26, 1924
2,159,234	Taylor -----	May 23, 1939
2,498,388	Ball et al. -----	Feb. 21, 1950
25 2,597,641	Hull et al. -----	May 20, 1952
2,622,277	Bonell et al. -----	Dec. 23, 1952
2,732,800	Coursen -----	Jan. 31, 1956
2,771,035	Clark -----	Nov. 20, 1956
2,858,289	Bohn -----	Oct. 28, 1958

30

OTHER REFERENCES

Chem. and Eng. News, May 27, 1957, pp. 22-3.