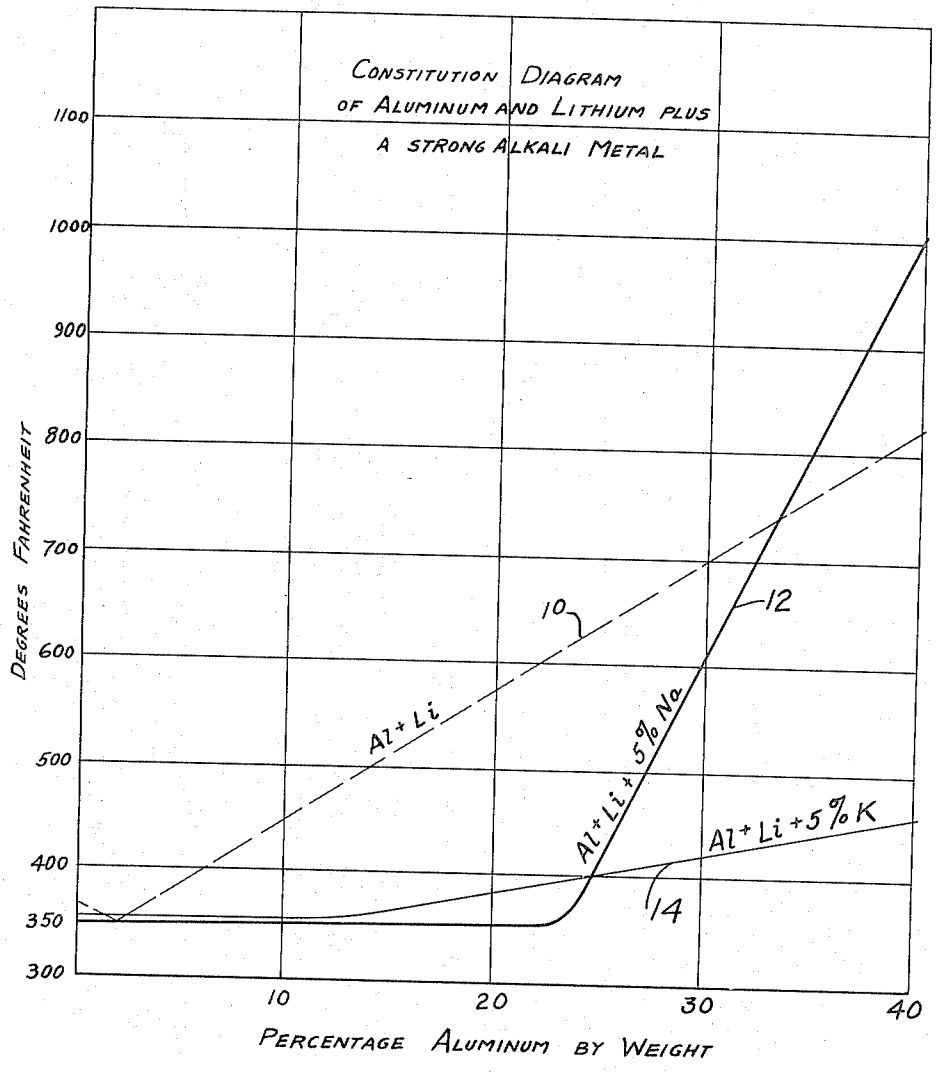
Jan. 17, 1956 O. T. PFEFFERKORN 2,731,342

WATER REACTIVE ALLOY

Filed March 24, 1952



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United States Patent Office 2,731,342
Patented Jan. 17, 1956

2,731,342

WATER REACTIVE ALLOY

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Application March 24, 1952, Serial No. 278,284

4 Claims. (Cl. 75—134)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a water reactive fuel for use in devices of the type wherein energy produced by the reaction between fuel and water is utilized.

Desirable characteristics of water reactive fuels are high heat energy content per unit volume, low melting point, inexpensiveness, and usable reaction products. A number of water reactive fuels have been tested in the past with varying success. An alloy containing about 25% sodium and 75% potassium has long been used in experimental work. The sodium-potassium eutectic melts at near 20° F., is relatively very cheap, and is easy to handle, but the heat of hydrolysis is only 1.25 K. cal./cc. The use of lithium has been considered in spite of its high melting point, corrosiveness, and high cost because lithium has a heat of hydrolysis of 3.7 K. cal./cc.

It has now been discovered that a water reactive alloy containing lithium, aluminum and a small proportion of a strong alkali metal has a higher total energy of reaction per unit volume than lithium. The ignition temperature of the fuel with water is lower than that of lithium with water, and the use of low cost aluminum brings the cost of the new alloy well below that of lithium. The aluminum which has a heat of hydrolysis of 9.6 K. cal./cc. serves to increase the total energy content of the alloy, and the strong alkali metal decreases the alloy melting point, promotes smoother burning, and provides positive ignition.

An object of this invention is to provide improved fuels wherein aluminum, lithium, and a strong alkali metal are alloyed to form high energy, low melting point, water reactive mixtures.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following description.

The single figure shows the constitution diagrams of aluminum and lithium plus a strong alkali metal such as sodium or potassium.

In the diagram, line **10** represents lithium-aluminum alloys. The melting point of pure lithium which is about 365° F. decreases slightly with the addition of a few per cent of aluminum until a eutectic point is reached. As more aluminum is added, the melting point rises sharply. Line **12** represents the melting point of lithium plus 5% of sodium based on total weight of alloy as increased amounts of aluminum are added. The lithium-sodium alloy has a melting point of about 350° F. which is increased only slightly by the addition of up to more than 20% of aluminum by weight. To obtain the advantages of inexpensiveness and high energy content of aluminum to the greatest extent possible without the necessity of employing high preheat temperatures with attendant corrosion and piping problems, a preferred composition contains 74% lithium, 5% sodium, and 21% aluminum. Line **14** represents the melting point of lithium plus 5% of potassium based on total weight of alloy as increased amounts of aluminum are added. Optimum proportions for alloys may be obtained from the constitution diagram. Representative data in the following table demonstrate the effect of varying the concentration of alkali metal.

Percent Aluminum	Percent Sodium	Percent Lithium	M. P., ° F.
20	3	77	345
30	3	67	610
20	6	74	335
30	6	64	600
20	9	71	335
30	9	61	590
20	12	68	330
30	12	58	590
10	6	84	350
20	6	74	350
30	6	64	430

Sodium is the least expensive of the alkali metals, and it also has the greatest energy per unit volume. The heats of hydrolysis of sodium, potassium, rubidium, and cesium are 1.84, 0.94, 0.8 and 0.68 K. cal./cc. respectively.

The alloys of the instant invention may conveniently be prepared by melting lithium with the alkali metal under a blanket of a dry inert gas such as helium or argon and then adding with agitation the desired amount of aluminum which readily disperses in the very fluid lithium-alkali metal mixture. The described alloys are sufficiently fluid to be pumped and nozzle injected at any temperature above the melting point. Such fuels are commonly preheated to about 50° F. above their melting point before injection into the water-containing reaction chamber, at which temperature the alloys are mobile.

It will be evident that the invention is not limited to any specific proportions and that the percentage of strong alkali metal present in the alloy may be varied.

The alloys of the instant invention are useful in the field of hydropropulsion, in compact steam generators, and the like.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A water reactive composition consisting of lithium mixed with 1% to 25% by weight of aluminum and 1% to 10% by weight of an alkali metal from the group consisting of sodium and potassium.

2. A composition melting below 400° F. capable of reacting with water which consists of from 1% to 25% sodium, 1% to 25% aluminum, and 65% to 90% lithium.

3. A water reactive composition consisting of lithium as the major component, from 1% to 23% of aluminum, and a proportion of an alkali metal from the group consisting of sodium and potassium effective to lower the melting point of said composition below 400° F.

4. A composition containing 74% lithium, 21% aluminum, and 5% sodium.

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