United States Patent Office 3,695,951 Patented Oct. 3, 1972

3,695,951

PYROTECHNIC COMPOSITION

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No Drawing. Filed June 25, 1970, Ser. No. 49,980
Int. Cl. C06d 1/02
U.S. Cl. 149—19 15 Claims

ABSTRACT OF THE DISCLOSURE

A pyrotechnic composition comprising (1) nickel, (2) a metal oxide or mixture of metal oxides, (3) a component selected from the group consisting of (a) aluminum and (b) a mixture of aluminum and a metal selected from the group consisting of magnesium, zirconium, bismuth, beryllium, boron and mixtures thereof provided that aluminum comprises at least 50% of said mixture and (4) a source of a gas.

BACKGROUND OF THE INVENTION

This invention generally relates to pyrotechnic compositions and more particularly to pyrotechnic compositions containing nickel and aluminum.

Pyrotechnic torches which are gaseous, liquid or solid fuel components have been developed for cutting or severing purposes. Most of these torches, however, transfer the energy obtained from the device by means of a jet of hot gases. The heat generated from most existing torches, whether they be solid, liquid or gaseous, is usually the result of reaction between a fuel component and an oxidizer and in most cases large quantities of oxidizer are required. The large quantity of oxidizer needed in these compositions creates a very serious safety problem. Though these devices have found extensive use they are not always dependable, efficient or economical. Exothermic alloying and oxidizing reactions which result in the evolution of large quantities of heat have been applied in the past to the pyrotechnic field as disclosed in Pat. No. 3,503,814, issued Mar. 31, 1970 to Horace H. Helms, Jr. and Alexander G. Rozner but improvement of the process described therein has been desirable.

SUMMARY OF THE INVENTION

Accordingly, one object of this invention is to provide a new pyrotechnic composition.

Another object of this invention is to provide a pyrotechnic composition which is relatively safe to handle.

Still another object of this invention is to provide a pyrotechnic composition which is easy to process.

Another object of this invention is to provide a pyrotechnic composition which reacts at a controlled rate to give off a large quantity of heat which is in a readily usable form.

Another object of the instant invention is to provide a pyrotechnic composition wherein energy transfer is accomplished by a high velocity jet of molten material rather than by gaseous jets.

A further object of this invention is to provide a pyrotechnic composition which is dependable, efficient and economical.

A still further object of the present invention is to provide a pyrotechnic composition suitable for use in a cutting torch.

These and other objects of this invention are accomplished by providing pyrotechnic compositions comprising (1) nickel, (2) metal oxide, (3) a component selected from the group consisting of (a) aluminum and (b) a mixture of aluminum and a metal selected from the group consisting of magnesium, zirconium, bismuth, beryllium, boron and mixtures thereof provided that aluminum comprises at least 50 weight percent of said mixture and (4) a source of gas.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The pyrotechnic composition of this invention as hereinbefore noted contains a number of different substituents.

The nickel present in the instant composition should constitute from 5–50 weight percent of the composition for best results with the range of 18–40 weight percent being most preferred.

The metal oxide or mixture of metal oxides of this composition should constitute from 20–76 weight percent of the composition with 25–60 weight percent being the preferred range. The preferred metal oxides are Fe_2O_3, Fe_3O_4, Cr_2O_3 and mixtures thereof. By the term "metal oxide" the inventors mean both one metal oxide and mixtures of various metal oxides.

The third component of the instant composition constitutes 15–50 weight percent and preferably 20–30 weight percent of the composition. This ingredient may consist entirely of aluminum or may be a mixture of aluminum and any one of or combination of the metals selected from the group consisting of magnesium, zirconium, bismuth, beryllium, boron and mixtures thereof provided that when such a mixture is used at least 50 weight percent of the mixture is aluminum.

A source of a gas is also present in the instant composition. The term "source of a gas" is intended to mean either one gas by itself, a mixture of gases, a material (solid or liquid) or mixture of materials which will produce a gas either by decomposition or vaporization, or mixtures of gases and materials which will produce a gas either by decomposition or vaporization. Thus, gases such as nitrogen, the inert gases, air or any mixtures thereof or any other gas or mixtures thereof that will not interfere with the alloying reaction will suffice. It is to be remembered that when a gas or a liquid material is being used as the source of the gas the entire composition must be placed in some type of container so that the gas or liquid will not dissipate. Thus, a gas or a mixture of gases would be charged into a container preferably under pressure which would be sealed. A suitable container may be of the type described in co-application Ser. No. 74,434 filed Sept. 22, 1970, entitled "Incendiary Torch" by Horace H. Helms, Jr., Alexander G. Rozner and Dana E. Spencer. When a container such as disclosed in the copending application is used the material is sealed into said container so that the gas pressure is maintained. When ready for use the material within the container, which in this case is a torch, is ignited and the alloying and oxidizing reaction starts. When the pressure inside the container exceeds the strength of the diaphragm the diaphragm fractures and the expanding gases will force the molten material through the nozzle.

Alternatively one may, instead of directly adding a gas to the torch, add a material to the instant composition which will decompose into a gas or vaporize into a gas when exposed to the heat which is produced by the alloying and oxidizing reaction after ignition of the torch. One may add to the instant composition solid materials such as powdered polytetrafluoroethylene (Teflon) or other solid materials which will decompose to form a gas or liquid materials which will vaporize and/or decompose to form a gas when exposed to the heat of the alloying and oxidizing reaction. It should be noted that the actual nature of the gas used is not believed to be important since it is believed that the main function of the gas is merely to expand as the heat of the alloying

and oxidizing reaction is applied to it thus creating a pressure which will force the pyrotechnic material out of the container in which the composition is present, as a jet of molten material. However, certain sources of gas such as powdered polytetrafluoroethylene are preferred because of their availability, ease of handling, efficiency and price. Furthermore, gases which contain fluorine are also preferred since it is believed that besides creating pressure to propel the molten material through the nozzle the fluorine in the gas partakes in some type of reaction with aluminum in an exothermic manner to further provide a source of heat to the pyrotechnic device. When a liquid is used as the source of the gas a container, though not necessarily a fully closed container as in the case of a gas containing composition, is necessary to prevent the liquid from running out of said composition. The source of a gas should constitute 1 to 20 weight percent of the composition when the source is either a solid or liquid with 5–15 weight percent being the preferred range. When the source of a gas is a gas, a mixture of gases or a mixture of a gas and either solids, liquids or mixtures thereof, the range of gas present should be greater than 0 weight percent to 20 weight percent. Polytetrafluoroethylene is the preferred source of a gas since when it is mixed in a powder form with the other constituents of the instant invention and compacted it imparts mechanical strength to the pellets made therefrom.

The general nature of the invention having been set forth, the following examples are presented as specific illustrations thereof. It will be understood that the invention is not limited to these specific examples but is susceptible to various modifications that will be recognized by one of ordinary skill in the art.

A few examples of typical compositions of this invention are as follows:

EXAMPLE I

	Percent by weight
Nickel	29.0
Aluminum	26.6
Fe_2O_3	39.4
Powdered polytetrafluoroethylene	5.0

EXAMPLE II

Nickel	17.6
Aluminum	24.4
Fe_2O_3	48.0
Powdered polytetrafluoroethylene	10.0

EXAMPLE III

Nickel	29.9
Aluminum	24.8
Fe_3O_4	35.3
Powdered polytetrafluoroethylene	10.0

It will of course be recognized by those skilled in the art that inert material can also be added to the compositions of this invention in order to slow down the reaction.

Obviously, numerous modifications and variations of the present invention are possible in 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 herein.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A pyrotechnic composition comprising a mixture of (1) nickel, (2) metal oxide, (3) a component selected from the group consisting of (a) aluminum and (b) a mixture of at least 50 weight percent aluminum and a metal selected from the group consisting of magnesium, zirconium, bismuth, beryllium, boron and mixtures thereof and (4) a source of a gas wherein said source of a gas is selected from the group consisting of (a) solid substance, liquid substance and mixtures thereof which will vaporize to form a gas when exposed to the heat of the alloying and oxidizing reaction, (b) solid substance, liquid substance and mixtures thereof which will decompose to form a gas when exposed to the heat of the alloying and oxidizing reaction and (c) mixtures thereof.

2. A pyrotechnic composition according to claim **1** wherein said metal oxide is selected from the group consisting of Fe_2O_3, Fe_3O_4, Cr_2O_3 and mixtures thereof.

3. A composition according to claim **1** wherein nickel constitutes 5–50 weight percent of the composition, metal oxide constitutes 20–76 weight percent, the component selected from the group consisting of (a) aluminum and (b) a mixture of at least 50 weight percent aluminum and a metal selected from the group consisting of magnesium, zirconium, bismuth, beryllium, boron and mixtures thereof, constitutes 15–50 weight percent and the source of a gas constitutes 1–20 weight percent of said composition.

4. A composition according to claim **3** wherein said source of a gas contains fluorine.

5. A composition according to claim **4** wherein said source of a gas is selected from the group consisting of fluorocarbons.

6. A composition according to claim **5** wherein said source of a gas is polytetrafluoroethylene.

7. A pyrotechnic composition according to claim **3** wherein said metal oxide is selected from the group consisting of Fe_2O_3, Fe_3O_4, Cr_2O_3 and mixtures thereof.

8. A composition according to claim **7** wherein said source of a gas contains fluorine.

9. A composition according to claim **8** wherein said source of a gas is selected from the group consisting of fluorocarbons.

10. The composition of claim **9** wherein said source of a gas is polytetrafluoroethylene.

11. A composition of claim **1** wherein nickel constitutes 18–40 weight percent of the composition, metal oxide constitutes 25–60 weight percent, the component selected from the group consisting of (a) aluminum and (b) a mixture of at least 50 weight percent aluminum of magnesium, zirconium, bismuth, beryllium, boron and mixtures thereof, constitutes 20–30 weight percent and said source of a gas constitutes 5–15 weight percent of said composition.

12. A pyrotechnic composition according to claim **11** wherein said metal oxide is selected from the group consisting of Fe_2O_3, Fe_3O_4, Cr_2O_3 and mixtures thereof.

13. The composition of claim **11** wherein said source of a gas contains fluorine.

14. A composition according to claim **13** wherein said source of a gas is selected from the group consisting of fluorocarbons.

15. A composition according to claim **14** wherein said source of a gas is polytetrafluoroethylene.

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U.S. Cl. X.R.

149—22, 37, 44, 87