

1

2,978,321

## OXIDATION RESISTANT ALLOY

James A. McGurty, Cincinnati, and Earl S. Funston, Hamilton, Ohio, assignors to General Electric Company, a corporation of New York

No Drawing. Filed Sept. 29, 1959, Ser. No. 843,301

3 Claims. (Cl. 75—150)

This invention relates to high temperature, oxidation resistant alloys and, more particularly, to binary alloys of yttrium and beryllium.

Neutronic reactors, which are operated at high temperatures require reflector and moderator materials capable of withstanding such temperatures. It is desirable to provide alloys which have good oxidation resistance in excess of 2000° F. for such applications. Furthermore, moderator and reflector structures require high strength and suitable nuclear properties for incorporation into these high temperature reactors. It is also desirable to increase the metallurgical field of alloys which might be employed in high temperature air applications.

The problem existed to develop high strength, oxidation resistant beryllium alloys with suitable nuclear properties for reflector and moderator applications. While beryllium metal has good strength at elevated temperatures, it was important to increase this strength for structural members. Although inorganic beryllium compounds display oxidation resistance at high temperatures, it would appear that these compounds have less thermal shock resistance than beryllium metal or beryllium alloys.

The invention of the present application provides high strength, oxidation resistant yttrium-beryllium alloys which are useful in air at temperatures in excess of 2000° F.

It is an object of our invention to provide a high strength alloy.

It is another object of our invention to provide an alloy which has superior oxidation resistance at temperatures in excess of 2000° F.

It is a further object of our invention to provide an alloy which is suitable for moderator or reflector application.

In carrying out our invention in one form, from 15.0 to 50.0 weight percent of yttrium is combined with beryllium to provide a high temperature, oxidation resistant alloy.

These and various other objects, features and ad-

2

vantages of the invention will be better understood from the following description.

We discovered unexpectedly that the combination of yttrium and beryllium produced alloys which had superior oxidation resistance and good strength in air at temperatures in excess of 2000° F. Furthermore, such alloys were suitable for use in moderator and reflector structures. The combination of from 15.0 to 50.0 weight percent of yttrium with beryllium provided these extraordinary effects. While this weight percent of yttrium with beryllium improved substantially the oxidation resistance of this alloy, from 38.0 to 48.0 weight percent yttrium appeared to be the optimum amount of this addition.

During the research which led to the discovery of these oxidation resistant yttrium-beryllium alloys, a series of small, vacuum melted, rare earth element buttons were prepared. These alloy buttons containing from 15.0 to 50.0 weight percent yttrium and the balance being beryllium were heated in air at 2600° F. for various time periods. The specimens were then examined metallographically and weight changes measured. The data tabulated in Table I shows the excellent oxidation resistance of these alloys containing approximately 43.0 weight percent yttrium and the balance being beryllium. At 2600° F., both yttrium and beryllium would be oxidized completely in a short time period.

TABLE I

Oxidation resistance of yttrium-beryllium alloys

[Air, 2600° F.]

| Hours | Weight Gain, mg./cm. <sup>2</sup> | Mils of Penetration |
|-------|-----------------------------------|---------------------|
| 16    | 12.8                              | 1.7                 |
| 48    | 16.5                              | 2.1                 |
| 100   | 28.3                              | 3.7                 |

While other modifications of this invention which may be employed within the scope of the invention have not been described, the invention is intended to include all such as may be embraced within the following claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A binary alloy of yttrium and beryllium which consists of from 15.0 to 50.0 weight percent yttrium and the balance being beryllium.

2. A binary alloy of yttrium and beryllium which consists of from 38.0 to 48.0 weight percent yttrium and the balance being beryllium.

3. A binary alloy of yttrium and beryllium which consists of approximately 43.0 weight percent yttrium and the balance being beryllium.

No references cited.