United States Patent [19]

Fabian

[11] **3,766,390**

[45] **Oct. 16, 1973**

[54] **TARGET FOR NEUTRON PRODUCTION IN ACCELERATOR INSTALLATIONS**

[75] Inventor: **Hans Fabian**, Hanau, Germany

[73] Assignee: **Nukem, G.m.b.H.**, Main, Germany

[22] Filed: **Aug. 10, 1971**

[21] Appl. No.: **170,431**

[30] **Foreign Application Priority Data**

Aug. 27, 1970 Germany ..... P 20 42 538.3

[52] **U.S. Cl.** ..... **250/499**, 313/61 R

[51] **Int. Cl.** **G21g 3/00**

[58] **Field of Search** ..... 250/84.5; 313/61, 313/61 R

[56] **References Cited**

UNITED STATES PATENTS

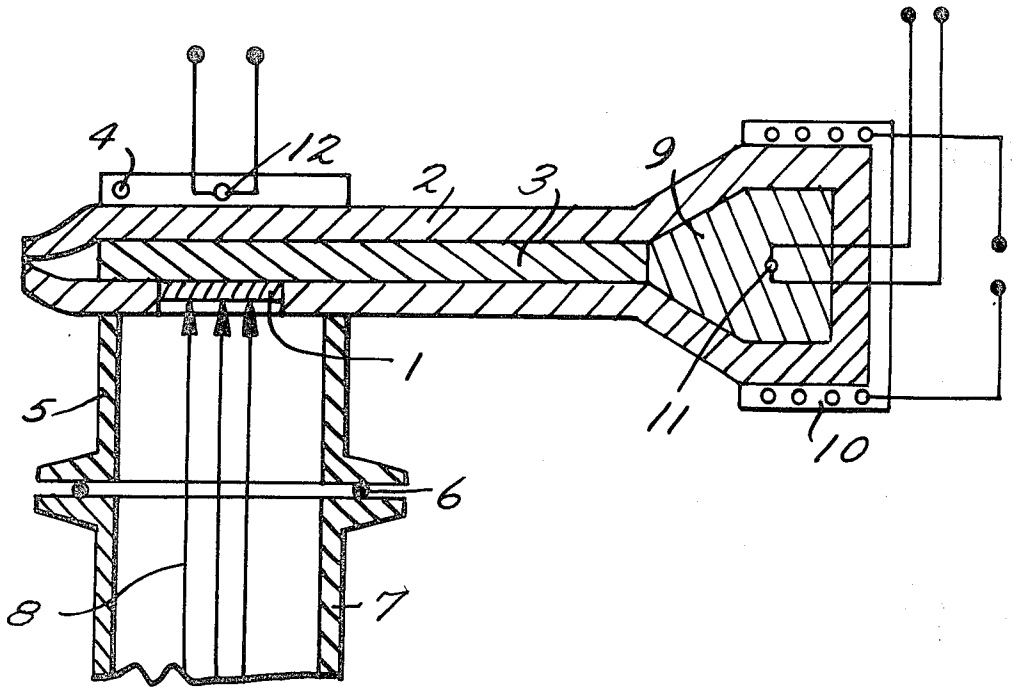
3,240,970	3/1966	Reifenschweiler	250/84.5
2,951,945	9/1960	Goodman	250/84.5
3,320,422	5/1967	St. John	250/84.5
3,646,348	2/1972	Detaint	250/84.5
2,943,239	6/1960	Goodman	313/61 R

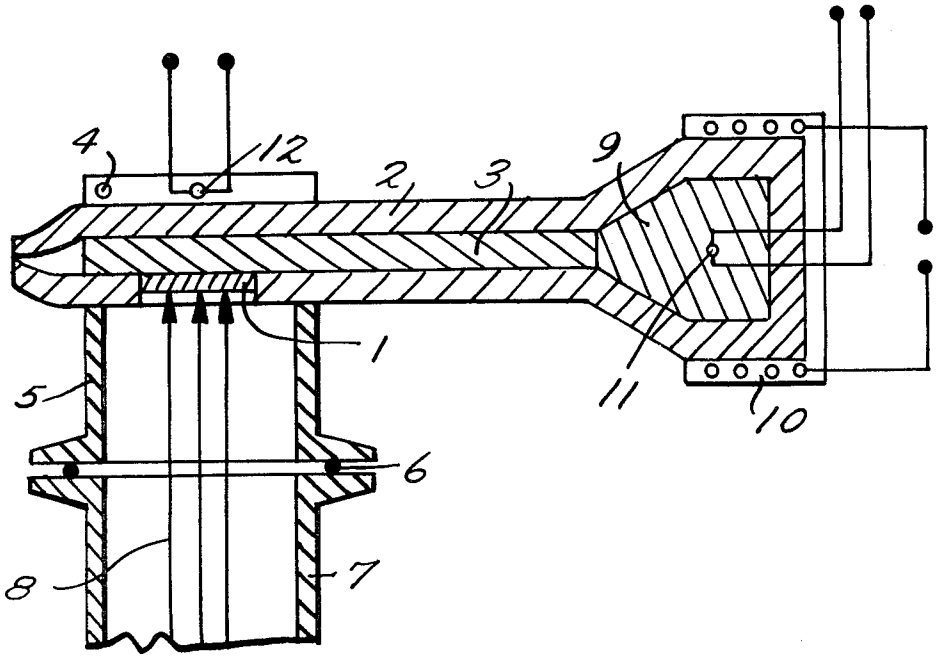
Primary Examiner—James W. Lawrence
Assistant Examiner—Harold A. Dixon
Attorney—Cushman, Darby & Cushman

[57] **ABSTRACT**

A target for neutron production is developed that is provided laterally of the target with a hydride accumulator from which the tritium is fed by heating of the target material.

7 Claims, 1 Drawing Figure





INVENTOR
Han Fabian

BY Cushman, Darby & Cushman
ATTORNEYS

TARGET FOR NEUTRON PRODUCTION IN ACCELERATOR INSTALLATIONS

The object of the invention is the development of a target for neutron production.

14MeV neutrons are formed if deuterium fired at tritium becomes $T(d,n)He^4$. The deuterium becomes an ionized gas in the vacuum, the tritium is added in solid form as the hydride. As tritium carriers there are used metals or metal compounds whose hydrides have a high hydrogen content. The number of neutrons produced depends upon how many tritium atoms are hit by the deuteron stream in their penetration of the target. Since the effective cross section of the T-D reaction is extremely small only a fraction of the deuterium fired at the target is used for the production of neutrons. The preponderant portion of the deuterium becomes embedded in the target.

The described mechanism of production requires that deuterium is increasingly accumulated in the target with progressive irradiation time. However, since the target already is present as saturated hydride, i.e., is laden with tritium, and additionally during the period of the irradiation hydrogen is introduced as deuterium, hydrogen must necessarily escape from the target. This loss of hydrogen becomes existant as a mixture of tritium and deuterium and results in the target being depleted of tritium and consequently a decrease in the neutron yield.

The object of the invention is the production of a target whose life is increased considerably by providing a hydride accumulator laterally of the target material from which the tritium is fed by heating the target material.

Preferably the supply is carried out over a hydrogen conductor, especially palladium, which produces a compound with the accumulator material and the target layer.

As target materials there can be used for example titanium hydride, scandium hydride, erbium hydride, Yttrium hydride, while as the accumulator there is employed uranium hydride or titan hydride.

In such an arrangement the target can be set up on an hydrogen impermeable support, e.g., copper, molybdenum, wolfram, aluminium in order to obtain a removal of the heat occuring during the firing of the target.

The single figure of the drawings is a cross sectional view of the apparatus.

Referring more specifically to the drawings there is provided an erbium target layer **1** fixed in a copper body **2** in the inner space of which there is inserted a palladium layer **3.** In the copper body there is provided a cooling channel **4** for the flow of cooling water. The copper body **2** is secured to a connecting piece **5** which is connected with the irradiation tube **7** of the accelerator by way of sealing gasket **6.** The deuterium stream

8 enters hereby in the direction of the arrows on the target layer **1.** Laterally of the described arrangement inside the copper body there is arranged a hydride accumulator **9,** preferably made of uranium hydride. This hydride body is surrounded by a heater **10** which can be heated by an electric heating means, e.g., from a 220 volt source. In order to measure the temperature in the heated body there is provided a thermocouple **11** and to measure the temperature of the target there is provided a thermocouple **12.**

If a reduction of the tritium content occurs through the firing of the neutrons tritium can be supplied to the target by way of the palladium layer **3** by heating the hydride body **9.** In this way there is attained a long uninterrupted time of operation of the neutron generator without a change of the tritium content of the target occurring. Since the copper support is practically impermeable to hydrogen the tritium which becomes free in the uranium hydride can only diffuse in the erbium hydride. By suitable variation of the target cooling and heating of the hydride accumlator material the tritium diffusion can be so controlled that there is always provided the desired tritium concentration in the target layer.

What is claimed is:

1. In a target means for the production of neutrons the improvement comprising a hydride accumulator located laterally of the target and means for heating said hydride accumulator to provide tritium therefrom including a metallic hydrogen conductor between the back of the target and the hydride accumulator and contacting both of them providing a direct solid contact between them.

2. A target means according to claim **1** wherein the hydrogen conductor is palladium.

3. A target means according to claim **1** comprising a hydrogen impermeable body having a widened portion, a target layer located in a portion of said body, a hydride accumulator located laterally of the target layer inside the widened portion of said body and a hydrogen conductor layer located laterally of the target layer inside said body and connecting said hydride accumulator with said target layer and means for heating said hydride accumulator.

4. A target means according to claim **3** and operatively connected thereto an irradiation tube of a neutron accelerator for impinging neutrons on said target layer.

5. A target means according to claim **4** where the heat accumulated in the target layer is exclusively removed through metal media.

6. A target means according to claim **3** wherein said hydrogen impermeable body is a copper body and said hydrogen conductor layer is palladium.

7. A target means according to claim **6** whrein the hydride accumulator is uranium hydride.

* * * * *