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ELECTRONIC DEVICE

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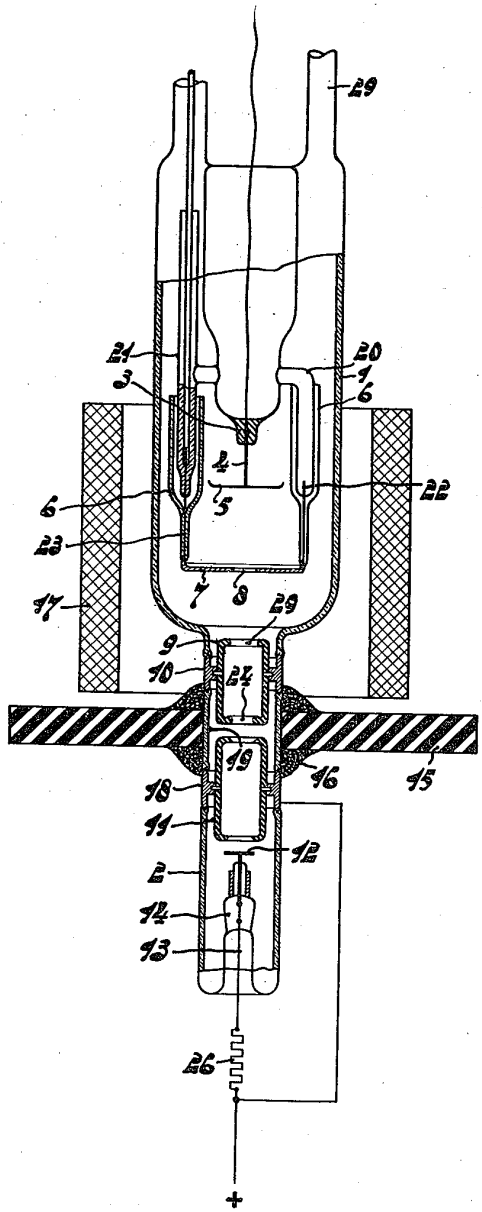

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ELECTRONIC DEVICE

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2 Claims. (Cl. 250—141)

My invention relates to a device for effecting a reaction between atom nuclei, and more particularly to a device for producing neutrons.

My invention is more particularly concerned with devices of the type in which ions produced in a glow discharge are projected against a material which when struck by the ions may cause a reaction of the nucleus. For instance by projecting heavy hydrogen ions against a material which contains, for example, heavy hydrogen, lithium and the like, neutrons can be produced during the resulting nucleus reaction. Hereinafter the material against which the ions are projected will be referred to as "a disc of impact." Such devices are also useful for effecting other nucleus reactions. For instance, they may be used to produce α particles by bombardment of a lithium compound with hydrogen ions (protons), according to the reaction $H^1+Li^7\rightarrow 2He^4$ or according to the reaction $H^2+Li^6\rightarrow 2He^4$. In the last-mentioned case lithium is consequently bombarded with ions of heavy hydrogen (deutons).

To produce neutrons in the above manner, devices are known in which a stream of ions of heavy hydrogen produced in a glow discharge space is passed into a second space of the device in which the pressure is lower than in the glow-discharge space. The ions are accelerated in the second space by applying a much higher potential, and they finally strike a disc of impact containing, for instance, a compound of heavy hydrogen. Neutrons are produced due to meeting of heavy hydrogen with a definite constituent of this compound, for instance of heavy hydrogen or lithium, according to the nucleus reactions which are already known.

Although such prior-art devices give satisfactory results, they have the serious disadvantage, that it is necessary to maintain different pressures in two communicating spaces, and for this purpose at least one of these spaces must be continuously connected to a vacuum pump during the operation of the device.

The object of my invention is to overcome this disadvantage, and to simplify devices of the above type.

The device according to the invention comprises an electric discharge tube having a plurality of interconnected portions in which the pressure is the same. The ions are produced in a glow discharge taking place in one portion and are accelerated in another portion, and strike finally a disc of impact, which contains a definite compound to produce the nucleus reaction. I influence the glow discharge by a magnetic field, and give this magnetic field such a configuration, and so shape the glow-discharge electrodes and so space the same with respect to the magnetic field that the discharge current is much stronger than it would be were the magnetic field not present.

By so arranging the magnetic field between the cathode and the anode that the electrons emitted from the cathode must cover a much longer path than that which they would cover without the magnetic field, the discharge current is as strong as it would be without a magnetic field with a much higher pressure of the gas. A second advantage of this arrangement is the fact that it is possible to strike the glow discharge which would be impossible without a magnetic field.

This effect of apparent pressure increase can be realized in various manners by means of the magnetic field. According to one embodiment of the invention the glow-discharge electrodes are shaped as flat plates arranged parallel to each other, and the magnetic field is so arranged that the magnetic lines of force extend perpendicularly to these plates. Thus not only an apparent pressure increase is obtained during operation of the tube, but also a decrease in ignition voltage which, of course, is also an important advantage. For example an apertured anode may be arranged centrally between two cathodes, of which one is also apertured for the passage of the ions produced.

In another embodiment the anode may be a cylinder or ring whose axis extends normally to the surface of the cathodes and parallel to the magnetic lines of force.

In the above cases the electrons move to and fro between the cathodes along curved paths, and generally reach the anode only after having repeatedly moved back and forth. Consequently these paths are appreciably longer than the direct path from the cathode to the anode, and as a result the effect produced is equivalent to an increase in the gas pressure.

In accordance with the various applications of a device according to the present invention, the gas in which the glow-discharge is struck and the substance bombarded by the ions produced are different. When the device is used for producing neutrons the glow discharge may be struck in heavy hydrogen and the ions produced may be projected against a disc of impact containing heavy hydrogen or lithium in some compound or

other; for example a compound of zirconium and heavy hydrogen.

In order that the invention may be clearly understood and readily carried into effect, I shall describe the same more fully with reference to the accompanying drawing which is a sectionized view of a device according to the invention.

The discharge device illustrated in the drawing comprises an envelope having a vitreous portion 1, two metal rings 10 and 18 for instance of chrome iron, a connecting vitreous portion 19, and a vitreous portion 2. Portion 1, which forms a glow-discharge chamber, is provided with a re-entrant part forming a pinch 3 and two tubular projections 20 and 21. Sealed in pinch 3 is a lead support 4 which carries on its lower end a cathode 5 in the form of a plate.

Beneath cathode 5 is an anode 7 in the form of a metal plate member, for instance of constantan provided with a central aperture 8. Anode 7 is supported at one side by a wire 22 sealed in the end of projection 20 and on its opposite side by a wire 23 sealed into the end of projection 21 and extending therethrough to serve as a lead. Supported by wires 22 and 23 are two vitreous cap-shaped members 6 which extend over the ends of projections 20 and 21 and serve to protect wires 22 and 23 from the discharge.

Supported from ring 10 is a second cathode 9 in the form of a metal cylinder, for instance of iron, whose ends are partly closed to form apertures 24 and 29. In a similar manner an accelerating electrode 11 in the form of a metal cylinder, for instance of iron, having partly closed ends is supported from ring 18.

Vitreous portion 2 forms a pinch 14 from which is supported a "disc of impact" 12 provided with a lead 13. The disc 12 may contain heavy hydrogen or lithium in some compound for example a compound of zirconium and heavy hydrogen.

Wherever throughout this specification the word "compound" is used not only a chemical compound is meant but also a body which contains a gas absorbed in it or adsorbed to it.

To prevent sparking over between rings 10 and 18, between which a potential difference of for instance 60 k. v. and more may be set up during operation, the tube is supported by a plate 15 of suitable insulating material such as "Bakelite," and a suitable insulating cement 16, such as pecine or similar material, is used to cover the surface of portion 19 and to hold the tube to plate 15.

Surrounding the central portion of the tube is a magnet coil 17 which produces in the discharge space a magnetic field whose lines of force extend substantially normally to the surface of cathode 5 and anode 7.

To reduce the detrimental effect of secondary electrons merging from the disc of impact 12, a resistance may be inserted in the supply lead 13. As shown in the drawing a resistance 26 is connected between lead 13 and the high-tension source whereas the ring 18 is directly connected to this high-tension source.

During the operation of the device the ions produced in the glow-discharge chamber pass through apertures 24 and 29 and, after being accelerated by electrode 11, strike the disc of impact 12 whereby neutrons are produced.

As a particular example a voltage of about 15 k. v. may be applied between cathodes 5 and 9 and anode 7, a voltage of about 60 k. v. may be applied between cathode 9 and electrode 11, and resistance 26 may have a value of about 1 megohm. During operation the tube has a filling of heavy hydrogen at a pressure of about 10^{-3} mm. Under such conditions coil 7 should produce a magnetic field having a value of about 800 gauss. The current may be of the order of magnitude of about 1 ma. in the main discharge and of the order of 0.1 ma. in the disc of impact 12.

If the pressure of gas filling within the tube becomes too high or too low due to the discharge, it may be readjusted in a known manner, for instance by means of palladium tubes or by means of tubes of zirconium which can absorb hydrogen as well as heavy hydrogen.

The pressure of the gas within a tube according to the invention may be advantageously measured and supervised by means of the device described in my copending U. S. patent application Ser. No. 106,915, filed October 21, 1936, which device utilizes the fact that at a low pressure and by using a suitable magnetic field, a glow discharge can be produced and the intensity of the current of this discharge used as a measure of the pressure. This may, for instance, be effected by sealing to the extension 29 of the tube of Fig. 1, a separate tube in which a glow discharge is struck at a low pressure in a suitable magnetic field. As more fully described in the above application the magnetic field and the anode voltage of this separate tube are so selected that, for the pressure range used, the intensity of the glow discharge current is a suitable measure of the value of the gas pressure.

While I have described my invention in connection with specific examples and applications, I do not wish to be limited thereto but desire the appended claims to be construed as broadly as permissible in view of the prior art.

What I claim is:

1. A device for effecting nucleus reactions comprising an envelope, a gaseous filling within said envelope, means within said envelope for producing a glow discharge comprising a cathode having a plate-shaped portion, a second cathode having a plate-shaped portion provided with an aperture and arranged parallel to said first portion, and an anode having an apertured plate-shaped portion centrally disposed between said cathode portions and extending substantially parallel thereto, a disc of impact within said envelope, means for accelerating the ions produced in the discharge toward the disc of impact to effect a nucleus reaction, and magnetic means to produce a magnetic field whose lines of force extend substantially perpendicularly to said portions.

2. A device for effecting nucleus reactions comprising an envelope, a gaseous filling within said envelope, means within said envelope for producing a glow discharge comprising a cathode having a plate-shaped portion, a second cathode having an apertured plate-shaped portion substantially parallel to said first portion, and an anode consisting of an annular member arranged with its axis normal to said cathode portions, a disc of impact within said envelope, means for accelerating the ions produced in the discharge toward the disc of impact to effect a nucleus reaction, and means to produce a magnetic field whose lines of force extend substantially normal to said cathode portions and parallel to the axis of the anode.

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