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ELECTRON ACCELERATOR

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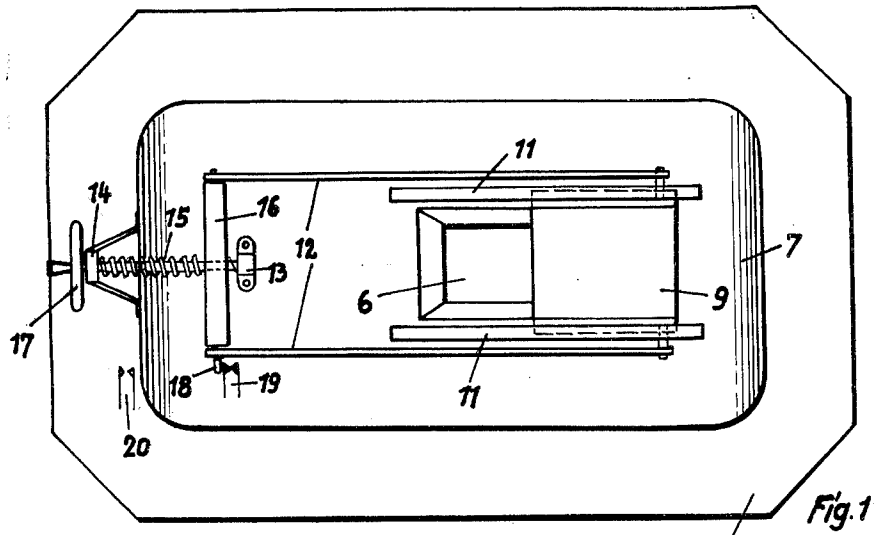

Fig. 1

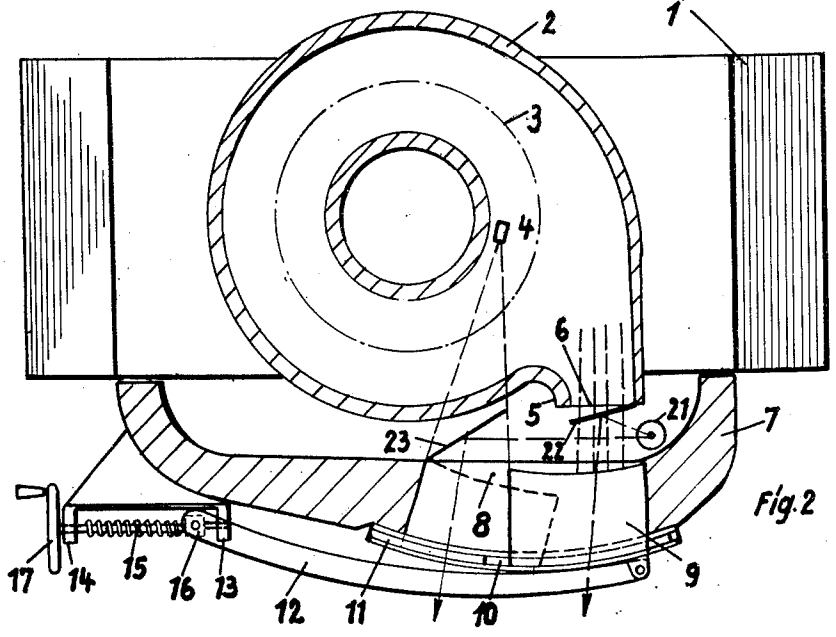

Fig. 2

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ELECTRON ACCELERATOR

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This invention is concerned with an electron accelerator having means for deflecting the electrons describing a circular orbit inwardly within the accelerating vessel, from this orbit onto an X-ray-producing target disposed inside the orbit and alternatively outwardly of said orbit, to produce X-ray radiation and electron radiation, respectively, and comprising separate radiation exit windows, one for electrons and the other for X-rays, and control means for selectively utilizing, e. g., for medical purposes, either one or the other radiation emerging from the respective windows.

The deflection means is in accordance with the invention alterable or switchable, e. g., to change the polarity of suitable field control means to cause the desired deflection of the accelerated electrons.

An auxiliary field or interference coil may be used through which is conducted a current impulse of predetermined direction, at the end of the electron acceleration, and a switch may be provided for controlling the direction of current flow of the impulse flowing through the coil.

A large X-ray radiation exit window may be provided in conjunction with a coacting adjustable, e. g., slidable, shield for selectively freeing predetermined portions of such window to permit passage of X-rays or of electrons emerging from the corresponding electron exit window. Suitable contact means may be operated by the displacement of the adjustable shield which effect the operative switching of the electron deflection means.

The objects indicated in the foregoing and additional objects and features will appear from the description of an embodiment of the invention which will be rendered with reference to the accompanying drawings. In these drawings,

Fig. 1 shows in diagrammatic representation an embodiment of an electron accelerator according to the invention, as seen from the front thereof; and

Fig. 2 is a transverse sectional view of the accelerator.

Numeral 1 indicates the magnet yoke of the accelerator and 2 a doughnut-shaped accelerating vessel. The dot-dash circle 3 in Fig. 2 denotes the orbital acceleration or equilibrium path of the electrons. An X-ray target 4 (anode) is disposed within the accelerating vessel inside of the orbital equilibrium path 3. The electron exit window 6 is provided in the neck 5 of the vessel 2. The accelerator is partly shielded by a lead shield 7 which is provided with the X-ray exit window 8. The window 8 is larger than is necessary for the desired X-ray radiation; that is, it is so large that the electrons emerging from the window 6 can pass therethrough.

Within the large window 8 is disposed a lead member 9 which is adjustable to form in one terminal position a shield to block the electron

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radiation from the exit window 6, while permitting the passage of the X-ray radiation. In its other terminal position the lead member 9 frees the part of the window 8 in the shield 7, which is required for the exit of the electrons.

The lead member 9 is secured to the bars 10 which are guided in cross-sectionally U-shaped rails 11. Movably connected with the lead member 9 are the arms 12. These arms are linked to the crossbar 16 which may be displaced for moving or shifting the lead member 9 from one to the other terminal position responsive to actuation of the sprindle 15 journalled at 13 and 14, the spindle being in threaded engagement with the crossbar 16 and being operable by the handwheel 17. The drive for the lead member 9 thus is a self-locking drive which holds the lead member in any position of adjustment. One of the arms 12 carries a pin 18 for operating contact springs 19 and 20 in the two respective terminal positions of the lead member 9.

The contact 19 governs the operation of a control device for switching in suitable means to deflect the electrons from the orbital equilibrium path inwardly whenever terminal velocity is attained; and the contact 20 is disposed in the circuit of control means for similarly switching in suitable means to deflect the electrons from the orbital equilibrium path outwardly whenever terminal velocity is attained.

The control device and the associated electron deflection means have not been illustrated in the drawings, because these means may be of any known kind for obtaining the desired and described results. The control device may, for example, comprise suitable electronic circuits and the proper elements therefor, for switching in and out at the proper times the electron deflection means; and the latter, in accordance with known practice, may comprise suitable field control means, for example, auxiliary windings on the magnet of the accelerator, for causing deflection of the electrons in the corresponding directions. The contacts 19 and 20 thus operate the control means in the manner of triggers which in turn cause momentary current impulses in the deflection coil means, to produce deflection of the electrons in the desired direction, either inwardly or outwardly of the orbital equilibrium path 3.

Inside of the shield 7 is provided a suitable light source 21 for projecting over the mirrors 22 and 23 two light beams indicated in Fig. 2 by arrows. The mirrors may be formed by foils of suitable material which is penetrable by the electrons from the window 6 and by the X-rays along the path to the window 8, respectively. The mirror 22 is disposed in the path of the electron radiation, and the mirror 23 is disposed in the path of the X-ray radiation. The light beams correspond in their spatial dimensions to

the dimensions of the electron and X-ray radiations, respectively.

Depending on the position in which the lead member 9 is adjusted—either for electron radiation from the window 6 or for X-ray radiation from the window 8—one or the other light beam corresponding thereto will be permitted to pass to the outside to indicate in the manner of a pointer the kind of radiation that is at any time effective.

We claim:

1. Electron accelerator having a vessel in which the electrons describe a circular orbital equilibrium path comprising means forming within said vessel inside of said orbital path an X-ray target, means for deflecting the electrons from the orbital equilibrium path inwardly onto said target and alternatively outwardly thereof, means forming separate radiation exit windows, one exit window for electrons and another exit window for X-rays, and control means for selectively switching in either one of said electron deflection means to produce X-ray and electron radiation, respectively, for emergence through the respective exit window.

2. The structure defined in claim 1, comprising X-ray radiation shielding means, a cutout provided in said shielding means forming said X-ray radiation exit window and a passage for electrons emerging from said electron exit window, movable shielding means, and means for moving said movable shielding means for selectively blocking either said X-ray radiation window or said electron radiation passage.

3. The structure defined in claim 2, comprising control means operated by said means for moving said movable shielding means to govern the operation of said deflection means.

4. The structure defined in claim 2, wherein said means for moving said movable shielding means comprises self-locking gear means.

5. The structure defined in claim 1, comprising means for producing a light beam to indicate the respective operatively effective X-ray radiation or electron radiation emerging from said windows.

6. The structure defined in claim 2, comprising means disposed between said X-ray radiation shielding means and said vessel to produce a light beam for individually indicating the respective radiation emerging from either one of said exit windows.

7. Apparatus for producing electron radiation and X-ray radiation, respectively, comprising an electron acceleration vessel in which the electrons are caused to move along a circularly extending orbital path, means forming inside of said orbital path an X-ray target, means forming in said vessel an electron exit window, X-ray radiation shielding means disposed outside of said vessel, an aperture formed in said shielding means, a radiation blocking member movably disposed in said aperture, and means for moving said blocking member to one terminal position within said aperture in which position the electron radiation from said electron exit window is blocked while the X-ray radiation is effected through the remainder of the area of said aperture and for alternatively moving said blocking member to the other terminal position in which the X-ray radiation is blocked while the electron radiation is effected from said electron exit window.

8. The structure as set forth in claim 7, in which the means for moving said radiation blocking member comprises means forming guideways for movably securing said blocking member, link means articulately connected with said blocking member, and self-locking gear means for moving said link means to move said blocking member.

9. The structure as set forth in claim 7, together with optical means for producing a beam of light trained to the outside to indicate the passage of X-ray radiation or electron radiation, respectively, from said vessel.

10. The structure as set forth in claim 7, together with optical means for producing a beam of light trained to the outside to indicate the passage of X-ray radiation or electron radiation, respectively, from said vessel, said optical means comprising a light source and two mirrors, one of said mirrors being disposed in the path of said X-ray radiation and the other mirror being disposed in the path of said electron radiation.

11. The structure as set forth in claim 7, together with contact means controlled by said means for moving said radiation blocking member, and control means governed by said contact means for effecting deflection of the electrons in said vessel relative to said orbital path.

12. The structure as set forth in claim 7, together with means for deflecting the electrons within said vessel relative to said orbital path, control means for governing said deflection means, and contact means controlled by the means for moving said radiation blocking member for governing the operation of said control means.

13. The structure as set forth in claim 7, together with coil means for deflecting the electrons within said vessel relative to said orbital path, control means for governing the current flow through said coil means, and contact means controlled by the means for moving said radiation blocking member for governing the operation of said control means.

14. The structure as set forth in claim 7, together with coil means for deflecting the electrons within said vessel relative to said X-ray target and said orbital path, respectively, control means for governing the current flow through said coil means, and contact means controlled by the means for moving said radiation blocking member which become operatively effective in the respective terminal positions thereof for governing the operation of said control means to effect alteration of the current flow through said coil means for the purpose of effecting deflection of said electrons upon terminal acceleration thereof.

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