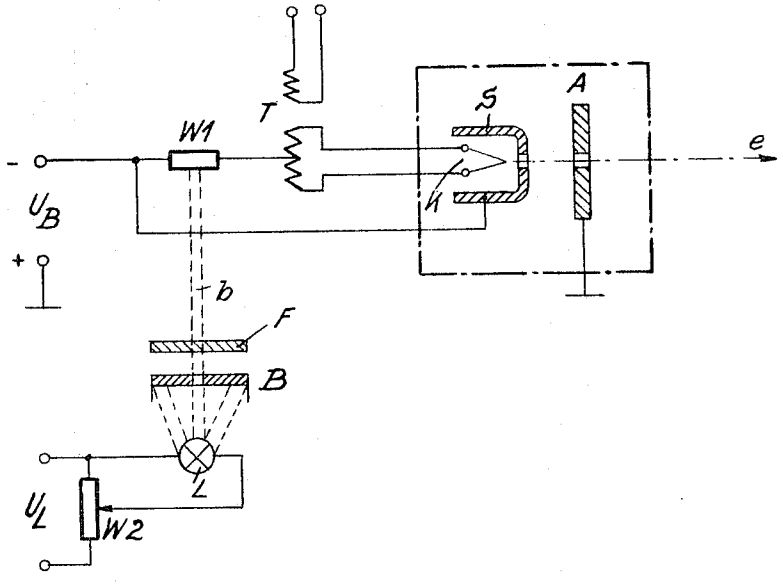
Dec. 20, 1966 A. ENGEL 3,293,483

RADIATION CONTROLLED ELECTRON RADIATION SOURCE

Filed Jan. 8, 1962 2 Sheets-Sheet 1

FIG. 1.



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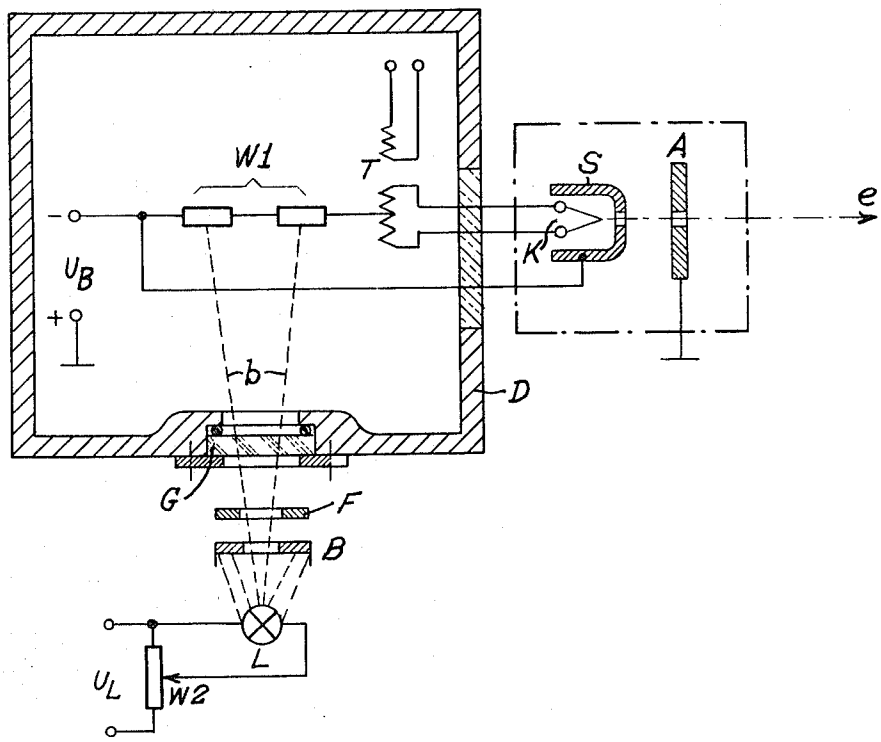
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RADIATION CONTROLLED ELECTRON RADIATION SOURCE

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Fig. 2



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United States Patent Office 3,293,483 Patented Dec. 20, 1966

3,293,483

RADIATION CONTROLLED ELECTRON RADIATION SOURCE

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Filed Jan. 8, 1962, Ser. No. 164,673
13 Claims. (Cl. 315—10)

The invention disclosed herein is concerned with an electron radiation or electron beam source, comprising an adjusting element or member with variable resistance, such element being disposed in the lead extending to the cathode and permitting the regulation of the power and the focusing of the electron beam emitted from the radiation source, by alteration of the cathode potential which is positive with respect to the potential of the control diaphragm.

The various objects and features of the invention will appear from the description of embodiments thereof which is rendered below with reference to the accompanying drawing.

The electron beam source is schematically indicated in the upper portion of the drawing. The cathode K which is supplied with heating voltage from the transformer T has a potential which is positive with respect to the potential of the control diaphragm S, since there is an adjusting element inserted in the lead extending to the terminals carrying the acceleration voltage U_B, such adjusting element being shown in the form of a resistor W1 at which a voltage drop appears in operation. The power as well as the focusing of the electron beam *e* which leaves the electron beam source proper, comprising the cathode K, the control diaphragm S and the anode A (shown within the dot-dash rectangle), can be regulated by alteration of the resistance value of the adjusting element W1, which may be effected, for example, mechanically.

Difficulties are experienced in connection with this known arrangement owing to the necessity of providing, in view of the very high acceleration voltage U_B, very good insulation for the actuating means required for the adjustment of the resistance value of the adjusting member W1. The use of a diode as an adjusting member W1, in place of the resistor indicated in the drawing, will necessitate an auxiliary transformer for the supply of the heating voltage of the diode and therewith for the adjustment of its saturation current, and said transformer must be constructed as an insulation alternator in view of the high acceleration voltage U_B. The requirement for a reliable insulation of all actuation means entails costly and extensive constructions.

Another disadvantage results from the nature of the mechanical actuation of the adjusting member in a case in which the equipment which delivers the high tension voltage serving as an acceleration voltage, is provided within a closed pressure vessel. It is for example necessary to dispose in such case the drive motor for the adjusting element within the pressure vessel, so as to obtain the required tightness, and such vessel must be of correspondingly large size or must be provided with tightly sealing lead-through means for the movable parts.

The problem underlying the invention resides in providing an arrangement which avoids these and other disadvantages and drawbacks of the known electron radiation sources.

The invention solves this problem by the provision of an electron beam radiation source comprising an adjusting element the resistance value of which can be varied by incident radiation, that is, a radiation sensitive adjusting element, preferably a cadmium sulphide resistor, and having, moreover, devices for producing the incident radiation as well as for the alteration of the values which characterize the incident radiation and which affect the resistance value of the radiation sensitive adjusting element.

Visible radiation such as is produced by light sources, can be utilized in many cases to serve as incident radiation. It is, however, also possible to use for this purpose invisible radiation, for example, heat radiation.

The above described difficulties, occasioned by the mechanical actuation of the known adjusting means, are avoided, owing to the fact that the adjusting element is actuated without mass, that is, that the actuation does not require mechanical actuating means.

In the drawings, wherein like reference characters indicate like or corresponding parts:

FIG. 1 is a diagrammatic figure of an electron radiation source embodying the invention; and

FIG. 2 is a diagrammatic figure, similar to FIG. 1, illustrating a modified form of the invention.

Referring to FIG. 1, the radiation sensitive adjusting element W1 is represented as a resistor. This adjusting element is irradiated by the radiation *b* which is produced by the radiation source L. The resistance of the adjusting element and therewith the potential difference between the cathode and the control diaphragm will be of different magnitude, depending upon the intensity of this radiation and the size of the irradiated area. The same effect can in many cases be produced by alteration of the spectral composition of the radiation *b*, since the elements employed as radiation sensitive adjusting members frequently exhibit a frequency dependence of the resistance value thereof.

A regulation of the resistance value of the adjusting member may accordingly be effetced, for example, by altering the intensity of the incident radiation *b* with respect to a constant irradiated area of the adjusting member W1. The drawing indicates several possibilities toward this end.

For example, the voltage U_L, supplied preferably from a commercial network, can be conducted to the radiation source L over a regulatable voltage divider W2, so that the voltage for the radiation source is adjustable. It is clear, of course, that other devices, for example, a regulatable transformer, may be used for this purpose in place of the regulatable voltage divider.

Another possibility for varying the intensity of the incident radiation resides in using gray filters F in the radiation path which holding the voltage constant.

Upon using color filters in place of gray filters F, the spectral composition of the radiation directed to the radiation sensitive adjusting member W1 will be varied, thus likewise effecting variation of the resistance value thereof.

It is also possible to vary instead of the intensity or the spectral composition of the radiation, as the value which characterizes the incident radiation, the cross-sectional size of the incident radiation and therewith the size of the irradiated area of the radiation sensitive adjusting member. One or more, preferably continuously adjustable diaphragms such as the diaphragm B may be used for this purpose, such diaphragm or diaphragms defining only a small angle from the entire radiation range of the radiation source.

It is of course understood that the various measures for the regulation of the resistance value of the adjusting member W1 may be employed in combination, as indicated in the drawing.

The switching elements used for the adjusting member are generally only in a limited sense voltage resistant, and light electrical resistors having considerable inertia,

that is, they require considerable time for assuming responsive to irradiation a resistance value lowered from an initially higher value, and it is therefore advantageous to construct the adjusting member of a plurality of serially successively arranged switching elements. This will make it possible to place the characteristic working point of the individual switching elements within a range of sufficiently low inertia. The different elements of the adjusting member, so far as the resistance value thereof is concerned, can be regulated by incident radiation emanating from a single radiation source. However, it may be of advantage, with a view of finer regulation of the resistance value of the adjusting member, to allocate to each element thereof a separate radiation source.

The advantages of the electron radiation source according to the invention become particularly apparent upon use thereof in connection with the previously noted case in which the adjusting member together with the means for producing the acceleration voltage are disposed within a closed pressure vessel. The dimensioning of the pressure vessel becomes practically independent of the radiation sensitive adjusting member since there are no mechanical actuating means that have to be considered and since the radiation which constitutes the actuating means can in simple manner be passed through a suitable window formed in a wall of the pressure vessel.

FIG. 2 illustrates the use of two switching elements for the adjusting member W1, which are enclosed in a pressure vessel D which would contain the means for producing the acceleration voltage. The vessel D is provided with a sealed window G, which is aligned with the elements of W1 and the radiation source L, whereby radiation from the latter may be directed through the window upon the elements of W1.

The amount of radiation striking the elements of W1 may be controlled by any one or combination of the regulating possibilities discussed with reference to FIG. 1, such as the adjustable voltage divider W2, grey or colored filters F, and one or more diaphragms B. The combination of the adjusting member, radiation source and means for controlling the operation of the radiation source with respect to the adjusting member, thereby controlling the operation of the latter, provides a unitary or self-contained control device that eliminates the disadvantages of the prior known arrangements.

Changes may be made within the scope and spirit of the appended claims which define what is believed to be new and desired to have protected by Letters Patent.

I claim:

1. An electron radiation source comprising the combination of a cathode and a control diaphragm, an adjusting member with variable resistance value disposed in a lead extending to the cathode, said adjusting member effecting by alteration of the potential of the cathode, which is positive with respect to the potential of the control diaphragm, control of the power and of the focusing of the electron beam emitted from the cathode, said adjusting member being sensitive to radiation whereby the resistance thereof is variable responsive to incident radiation directed thereagainst, means, associated with and forming a part of said source, for respectively producing the incident radiation and means, likewise associated with and forming a part of said source, for altering the values which characterize the incident radiation and thereby affect the resistance value of the radiation sensitive adjusting member.

2. An electron radiation source according to claim 1, wherein a cadmium sulphide resistor constitutes said adjusting member.

3. An electron radiation source according to claim 1, wherein said incident radiation is a visible radiation produced with the aid of a light source.

4. An electron radiation source according to claim 3, comprising a voltage source for supplying current to said light source, circuit means for connecting said voltage source to said light source, and a regulatable voltage divider included in said circuit means for varying the intensity of said incident radiation which is applied for irradiating a defined area of said radiation sensitive adjusting member.

5. An electron radiation source according to claim 3, comprising gray filter means for varying the intensity of said incident radiation which is applied for irradiating a defined area of said radiation sensitive adjusting member.

6. An electron radiation source according to claim 3, comprising color filter means for varying the spectral composition of said incident radiation which is applied for irradiating a defined area of said radiation sensitive adjusting member.

7. An electron radiation source according to claim 1, wherein said incident radiation is of constant intensity and spectral composition, comprising control means for varying the cross-sectional area of said incident radiation and therewith the area of irradiation of said radiation sensitive member.

8. An electron radiation source according to claim 1, wherein said incident radiation is of constant intensity and spectral composition, comprising continuously adjustable diaphragm means for varying the cross-sectional area of said incident radiation and therewith the area of irradiation of said radiation sensitive member.

9. An electron radiation source according to claim 1, comprising control means for respectively varying parameters which affect the operation of said radiation sensitive adjusting member, said parameters including the intensity and spectral composition of said incident radiation and the area of the adjusting member which is being irradiated.

10. An electron radiation source according to claim 1, wherein said adjusting member is composed of a plurality of serially connected radiation sensitive elements.

11. An electron radiation source according to claim 1, wherein said radiation sensitive member is composed of a plurality of serially connected cadmium sulphide resistors.

12. An electron radiation source according to claim 1, wherein said radiation sensitive member is composed of a plurality of cadmium sulphide resistors, and a source individual to each resistor for producing the radiation energy thereof.

13. An electron radiation source according to claim 1, in combination with a device for producing a high tension voltage serving as an acceleration voltage, said device and said radiation sensitive adjusting member being enclosed within a pressure vessel, and a window formed in a wall of said vessel through which said incident radiation is directed for the irradiation of said adjusting member.

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