

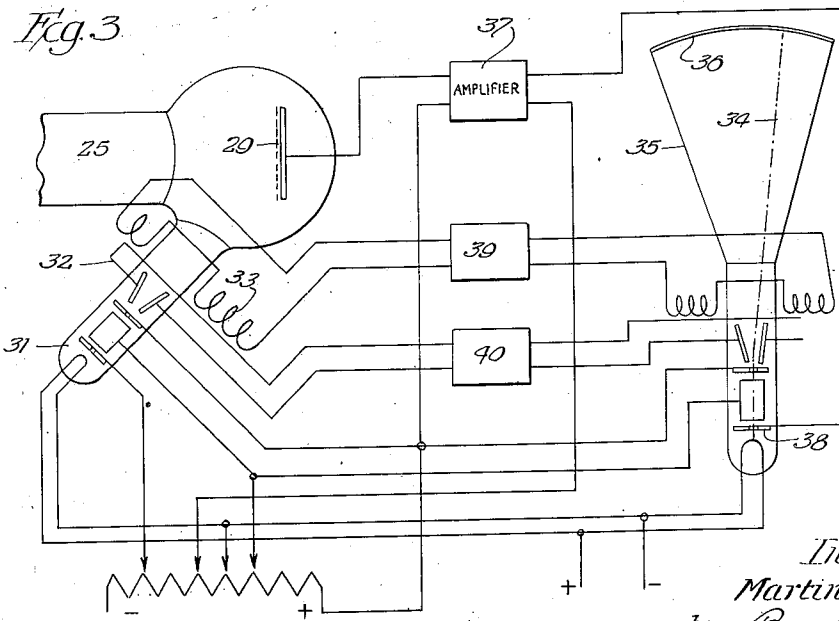
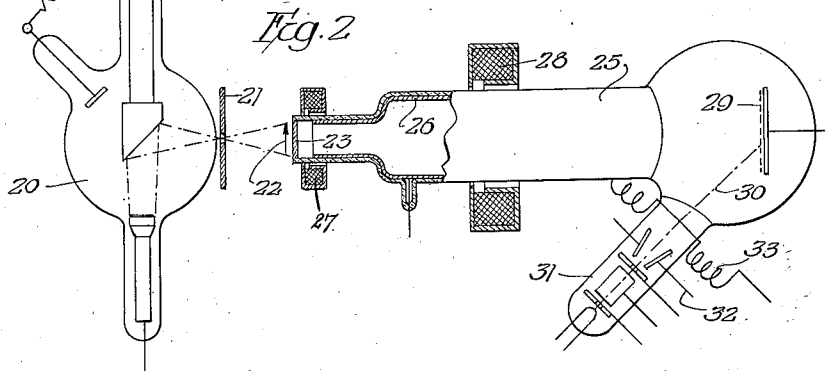
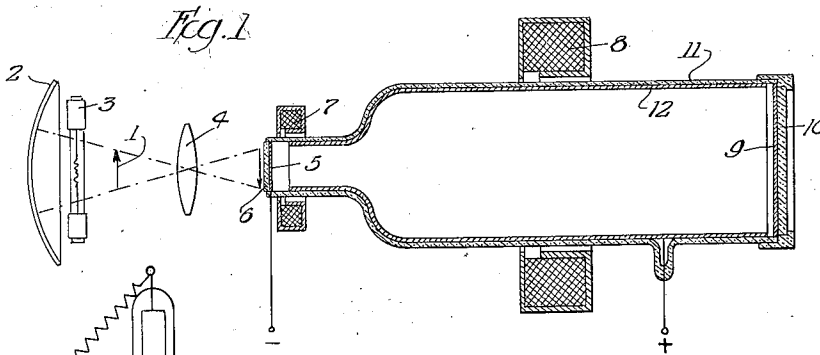
Oct. 22, 1940.

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2,219,113

METHOD OF ELECTRON-MICROSCOPICALLY INVESTIGATING SUBJECTS

Filed Oct. 2, 1937



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UNITED STATES PATENT OFFICE

2,219,113

METHOD OF ELECTRON-MICROSCOPICALLY
INVESTIGATING SUBJECTSMartin Floke, Dresden, Germany, assignor to Zeiss
Ikon Aktiengesellschaft, Dresden, GermanyApplication October 2, 1937, Serial No. 167,051
In Germany October 2, 1936

2 Claims. (Cl. 178-7.2)

The invention relates to improvements in electron-optics and particularly to electron-microscopy.

In electron-microscopy three methods have been developed principally. According to one method the subject, consisting for instance of a filament, is observed in its own electron light, produced by rendering the filament incandescent. The other two methods are applicable to subjects which do not emit electrons and these methods are based on irradiation of the subject with electrons or on passage of electrons through the subject to be investigated.

The present invention has the object of avoiding the production of heat which accompanies the bombardment of an article with electrons.

For this purpose the invention has as its object a method of producing primarily an image of the subject on a photo cathode, and then enlarging this image electronoptically.

The invention furthermore has the object of producing this enlargement of the cathode image by means of electrical or magnetical lenses.

The invention furthermore has the object of permitting in electron-microscopy that the subjects can be changed rapidly and without difficulties, as contrasted with known methods in which the subject had to be positioned within a vacuum.

Another object of the invention is to project the image of the subject on the photo cathode by rays of short wave length, for instance by X-rays, avoiding eventually any projection by long wave light rays which are visible. The base on which the photo-electric layer of the cathode is positioned preferably consists of a material which permits the passage of ultra-violet rays, as for instance, quartz. When employing X-rays it is feasible to use as a photo cathode thin metal foils of the type known as Lenard windows. Since the present invention requires a photo cathode, or Lenard window respectively, of very small dimensions only, the cathode is eminently adapted to withstand the outer air pressure.

In the method of the present invention is employed to produce very great enlargements, it may happen that the intensity of the light in which the image appears on the fluorescent screen of the electron microscope is very weak.

The invention therefore also has the additional object of intensifying this illumination by using a process screen similar to screen plates known from the printing process in place of the fluorescent screen. These screens, called mosaic electrodes in television receiving tubes, have an integrating ef-

fect, as each of the projecting point of the screen plate may be charged to a predetermined degree through concentration of the electrons emitted from the photo cathode on the projections of the plate. The electrical impulses produced by the charges are amplified and are used to control the electron beam of a Braun tube on whose fluorescent screen the electron-optically enlarged image will appear with sufficient brightness. The fluorescent screen of the Braun tube may also be replaced by a screen consisting for instance of a great number of cells which change their light-permeability under the influence of the electron beam striking the same.

The drawing illustrates by way of example two embodiments of the invention.

Fig. 1 shows diagrammatically an arrangement in which the subject to be examined is illuminated by ultra-violet rays.

Fig. 2 illustrates diagrammatically a modified system in which the subject to be examined is exposed to X-rays, the electron image on a screen cathode being scanned, and the scanning impulses being utilized for controlling the electron beam of a Braun tube, and

Fig. 3 illustrates diagrammatically the transmission of the scanning impulses to a Braun tube.

According to Fig. 1, the subject 1 is illuminated, as for instance a short length of filament, with ultra-violet rays produced by the high pressure mercury lamp 3 arranged in front of the parabolic reflector 2. A lens 4 or similar optical means projects a true image of the subject 1 onto the photo cathode 5 positioned on the interior face of a quartz window 6. The electrons emitted from the photo cathode 5 and influenced by the magnetical lenses 7 and 8 produce upon the fluorescent screen 9 an enlarged image of the subject 1. The fluorescent screen 9 is arranged upon the transparent cover plate 10 of the evacuated tube 11, which is provided in its interior with the anode 12. A voltage of about 50,000 volts is applied between the photo cathode 5 and the anode 12.

The modified embodiment of Fig. 2 employs an X-ray tube 20 in front of which a diaphragm 21, preferably consisting of lead, is arranged. The X-rays project an image of the subject 22 on a thin metallic window pane 23 which forms a closure on the reduced portion 24 of the evacuated tube 25. The X-rays cause the metallic foil 23 to emit electrons and these electrons are concentrated upon the cathode screen 29 owing to the influence of the anode 26 and the magnetical lenses 27 and 28. The electron image

appearing on the cathode screen 29 is scanned by an electron beam 30 produced in the scanning assembly 31 which comprises the customary electrode arrangement as indicated. The beam being oscillated by the deflecting plates 32 and deflecting coils 33 respectively. The charge impulses produced during the scanning are employed for controlling the electron beam 34 of a Braun tube 35.

Fig. 3 shows diagrammatically how this may be accomplished. This Fig. 3 shows the electrical circuit connections leading uniting the electrodes of the tubes 25 and 35. The impulses taken from the screen cathode 29 are conducted to an amplifier 37 and then to the control electrode 38 of the Braun tube. The elements indicated at 39 and 40 produce the oscillations on the deflecting plates 32 and the deflecting coils respectively of the tube 25 and the Braun tube 35.

What I claim is:

1. In a system for producing enlarged images of subjects, an electron tube comprising an elongated evacuated vessel having a reduced end portion, a metallic foil closing said reduced end portion and adapted to emit electrons when an image of the subject is projected on the same by X-rays, a cathode screen mounted within said vessel at the other end thereof, a tubular anode extending along the inner wall of said vessel from adjacent said metallic foil toward said cathode screen, means forming magnetical lenses mounted around said elongated vessel for concentrating the electrons emitted by said metallic foils, one of said magnetical lens means being mounted around the reduced end portion of said vessel and another one surrounding the said vessel at a

place substantially midway between its ends, said anode and magnetical lens forming means being operable to project a magnified electron image of the subject on said cathode screen; said elongated vessel being provided with a tubular extension within which are mounted means for generating a ray of electrons and directing the same at said cathode screen, and means causing said ray to scan said cathode screen.

2. In a system for producing enlarged images of subjects, an electron tube comprising an elongated evacuated vessel having a reduced end portion, a metallic foil closing said reduced end portion and adapted to emit electrons when an image of the subject is projected on the same by rays of short wave length, a cathode screen mounted within said vessel at the other end thereof, a tubular anode extending along the inner wall of said vessel from adjacent said metallic foil toward said cathode screen, means forming magnetical lenses mounted around said elongated vessel for concentrating the electrons emitted by said metallic foils, one of said magnetical lens means being mounted around the reduced end portion of said vessel and another one surrounding the said vessel at a place substantially midway between its ends, said anode and magnetical lens forming means being operable to project a magnified electron image of the subject on said cathode screen; said elongated vessel being provided with a tubular extension within which are mounted means for generating a ray of electrons and directing the same at said cathode screen, and means causing said ray to scan said cathode screen.

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