

June 16, 1931.

D. E. HOWES

1,810,018

CATHODE RAY OSCILLOGRAPH

Filed May 28, 1924

Fig. 1.

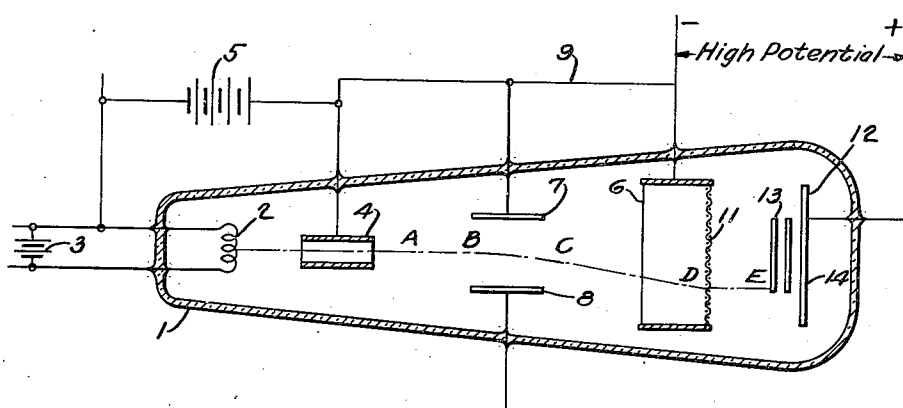
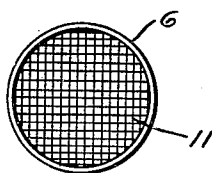


Fig. 2.



WITNESSES:

L. H. Voelker

W. H. D. H. H. H. H.

INVENTOR

Douglas E. Howes.

BY

Verley & Carr

ATTORNEY

UNITED STATES PATENT OFFICE

DOUGLAS E. HOWES, OF NORTHFIELD, VERMONT, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

CATHODE RAY OSCILLOGRAPH

Application filed May 28, 1924. Serial No. 716,294.

This invention relates to oscillographs and particularly to oscillographs of the type which depend upon the deflection of a cathode ray for obtaining an indication of the quantity to be observed.

Cathode rays, when they impinge upon a fluorescent substance or upon a photographic plate, produce effects which are greater with greater velocity of the electrons.

The electrostatic or magnetic field acting to deflect a cathode ray, produces an effect which is greater the slower the motion of the electrons in the ray. The condition for maximum deflection is, therefore, the opposite of that for maximum effect at the fluorescent screen or photographic plate.

It is an object of this invention to overcome the seeming inconsistency of these conditions and produce a cathode ray oscillograph in which deflections are greater and, at the same time, the effect at the fluoroscope is greater, than has heretofore been possible.

Because of the conditions which have heretofore been regarded as conflicting, oscillographs which were sensitive, that is, which gave a large deflection in response to a small voltage or current, have required a long exposure in order to obtain a record upon the photographic plate. Such oscillographs could not, therefore, be used for recording brief transient phenomena. On the other hand, oscillographs in which the velocity in the rays is sufficiently high for a brief exposure to produce a record upon the plate, have not heretofore been very sensitive. It is a further object of this invention to obtain an oscillograph which may be used for the observation of transient phenomena and yet shall be sufficiently sensitive to record small voltages or currents.

It is a further object of this invention to produce a cathode-ray tube in which the rays have different accelerations at different parts of their path.

It is a further object of this invention to successively give to electrons a small acceleration to produce cathode rays of small velocity, deflect the rays while they have this small velocity, produce a large acceleration to give to the rays a great velocity and finally

to have the rays, with their great velocity, strike the sensitive target.

It is a further object of this invention to provide devices for confining the electrons to a definite stream, inserting said devices at each end of that portion of the cathode ray path within which the deflections occur.

It is a further object of this invention to maintain that component of the field which is lengthwise of the rays, constant over substantially the whole of that space within which the deflection occurs.

Other objects of the invention and details of construction will be apparent from the following description and the accompanying drawings in which:

Fig. 1 is a diagrammatic view of an oscillograph, showing the relative location of the parts involved in my invention, and

Fig. 2 is a side view of one of the electrodes.

The oscillograph is illustrated as comprising various electrodes mounted within an evacuated envelope 1. The electrodes include a cathode 2, which is heated by current supplied from the battery 3.

At a small distance from the cathode, there is mounted a tubular electrode 4, the axis of the tube being parallel to the length of the envelope 1. A sufficient difference of potential is maintained between the cathode 2 and the tubular electrode 4 to give a moderate acceleration to the electrons emitted from the cathode 2. This difference of potential, indicated by the battery 5, is preferably of the order of from 300 to 500 volts.

The tubular electrode 4 acts to confine the electrons emitted from the cathode 2 to one narrow stream, because all electrons, which do not travel nearly parallel to the axis of this tube, impinge upon the walls thereof and get no further.

A second tubular electrode 6 is spaced from the tube 4, a distance sufficient to accommodate the deflection plates 7 and 8. Any other known deflecting means may be substituted for plates 7 and 8. The tube 4, the plate 7 and the electrode 6 are at the same potential. This is indicated on the drawing by showing a conductor 9 connecting them.

The source of the voltage to be observed is connected between the plates 7 and 8. The resulting electrostatic field produces a deflection upon the low velocity electron stream, constituting the cathode ray passing between the tube 4 and the electrode 6.

The end of the cylinder 6, farthest from the tube 4, is covered with a grating or foraminated plate 11. Each of the openings in this screen constitutes, in effect, a short tube whose axis is parallel to the tube 4. The cathode rays, upon passing the screen, emerge in a direction parallel to the original direction given by the tube 4. The action of each foramen tends to confine the electrons passing therethrough to a narrow, directed stream, in the same way as the tube 4.

At the end of the envelope 1 opposite the cathode 2, an anode 12 is provided, between which and the electrode 6, a high difference of potential is maintained. Preferably, this is of the order of from 10,000 to 20,000 volts. In order to indicate that this difference of potential is greater than that of the battery 5, the legend "high potential" has been placed on the drawing. In front of the plate 12, that is, between it and the electrode 6, there is a fluorescent screen 13.

This screen can serve as a means for observing the amount of deflection of the cathode ray, but, preferably, a photographic plate 14 is provided, upon which a record may be obtained. Any of the usual expedients by which the plate can be removed from and replaced in position, may be used. Since these expedients form no part of the present invention, they are not illustrated or further described.

In the operation of the device, electrons emerge from the heated cathode 2. The action of the battery 5 causes these electrons to be accelerated toward the tube 4. The tube confines them into a stream or cathode ray. The velocity of the electrons, at this part of their path, is determined by the difference of potential between the cathode 2 and the tube 4 and is not very large. For this reason the cathode ray, between the tube 4 and the electrode 6, is of moderate velocity only.

The path of the ray is illustrated by the line A. This line is straight from the tube 4 to the point B where the electrons enter the field between the plates 7 and 8. The deflecting action of this field is illustrated by the curve extending from B to C. Between C and the point D, the path is again straight, but is at an angle to the length of the tube 1.

If this angle is so great as to cause some of the electrons to impinge against the side walls of the short tubes or foramina, only those electrons which are moving approximately parallel to the length of the tube, will emerge from the grating 11. Consequently, the part D E of the path is again parallel to the axis of the tube 4.

Over the part D E, the acceleration is very

great because of the high potential difference between the electrodes 6 and 12. Consequently, the effect of the grating 11 upon the deflection of the rays is assisted by the stronger field between 11 and 12.

The cathode rays at the point E are high-velocity rays, that is, the electrons impinge upon the target 13 with great velocity. The fluorescence developed, therefore, is great, or if a photographic plate, without a fluorescent screen is used, the photographic effect is great. A brief exposure is, therefore, sufficient to obtain a record.

As the voltage or current under observation varies, a corresponding change occurs in the deflection of the cathode ray and the point D moves about on the screen 11. As the point D passes across a wire of the grating, an interruption of the ray occurs. The curve traced by the point E on the fluorescent screen or the photographic plate is consequently broken up into dots. The interruptions in this curve assist in interpreting the record, because each interruption stands for a passage of the point D over a bar of the grating.

Other modifications besides those herein illustrated and described will readily occur to those skilled in the art. It is not intended that the fact that but one apparatus is specifically illustrated and described shall be considered as a limitation. No limitation except that required by the prior art and indicated in the claims is contemplated.

I claim as my invention:

1. In a vacuum-tube device, a cathode, a tube for confining the electrons from said cathode to a small stream, means for maintaining a difference of potential between said tube and said cathode, an electrode spaced away from said tube, means for maintaining said electrode at the same potential as said tube, control means located between said tube and electrode for deflecting the electron stream according to the quantity to be observed, an indicating device with which said stream contacts on the other side of said electrode from said tube, and means for maintaining a greater difference of potential between said electrode and said indicating device than said first mentioned difference of potential.

2. In a vacuum-tube device, a cathode, a tube for confining the electrons from said cathode to a small stream, means for maintaining a difference of potential between said tube and said cathode, an electrode spaced away from said tube, comprising a tubular element approximately parallel to said tube, means for maintaining said electrode at the same potential as said tube, control means located between said tube and electrode for deflecting the electron stream according to the quantity to be observed, an indicating device on the other side of said electrode from said tube, and means for maintaining a higher

difference of potential between said electrode and said indicating device than said first mentioned difference of potential.

3. In a cathode-ray indicating device, a source of electrons, an electrode, means for maintaining a difference of potential between said source and said electrode, an anode, means for maintaining a larger difference of potential between said electrode and said anode than between said source and said electrode, and means, controlled by a variable quantity, for deflecting said electrons between said source and said electrode and an indicating surface with which said electrons coact.

4. In a cathode-ray tube, a source of electrons, a tube confining the electrons into a stream, and a foraminate plate at the same potential as said tube, the axes of the foramina being parallel to said tube, means between said tube and said plate for deflecting the stream, and means for increasing the speed of said electrons after leaving said plate.

5. In a cathode-ray indicating device, means for producing a beam of electrons of low velocity, means for deflecting said beam in proportion to a variable quantity, means for accelerating said beam of electrons after said deflection, and means more sensitive to high velocity electrons than to low velocity electrons for indicating the degree of the deflection.

6. In a cathode-ray device comprising an indicating surface and an anode having an aperture, the method which comprises causing a beam of electrons to pass through said aperture and leave said anode at low velocity, deflecting said beam of electrons in accordance with a variable quantity while the electrons are moving at said low velocity, accelerating said electrons after said deflection, and receiving said electrons upon said indicating surface.

7. In a cathode-ray indicating device, means for producing a stream of electrons of low velocity, means for controlling said stream of electrons while the electrons are moving at said low velocity, means for accelerating said stream of electrons after said stream has been controlled by said second means, and an indicating surface more sensitive to high-velocity electrons than to low-velocity electrons positioned in the path of said accelerating electrons.

8. In a cathode-ray indicating device, a source of electrons, an anode, means for maintaining a difference of potential between said source and said anode, a second anode, means for maintaining a larger difference of potential between said first anode and said second anode than between said source and said first anode, and means, controlled by a variable quantity, for deflecting said electrons between said first anode and said sec-

ond anode, and an indicating surface with which said electrons coact.

In testimony whereof, I have hereunto subscribed my name this 14th day of May, 1924.

DOUGLAS E. HOWES.