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IMAGE TUBE

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This invention relates to image tubes, or devices. In particular, this invention relates to electron-image tubes that are particularly adapted to high speed intelligence transmitting systems.

For many purposes it is desirable to have a means to select a portion of a visible image, orient this selected portion of the visible image in a given manner, and reproduce the information obtained. On example of this is to transform information that is contained on a teletypewriter tape into written information. Another example is for decoding coded messages.

Various mechanical devices have been designed to convert some type of coded information into de-coded information. However, these mechanical devices, such as teletype printers, have the disadvantage of being slow in operation.

Various electrical devices have overcome the slow movement involved in mechanical devices but these electrical devices have had the disadvantage of not permitting a complete message to be printed at one time.

While still other electrical devices have provided a means to reproduce a complete message at one time, these devices incorporate the scanning of a character by an electron beam and do not provide high definition in the final printed message. Some of these electrical devices have also been limited by the disadvantage of not being able to interchange the matrix containing the characters scanned in the device without disassembling the envelope.

It is therefore an object of this invention to provide a new and improved image device, or tube.

Another object of this invention is to provide a new and novel image device that eliminates the function of scanning in the formation of a character by an electron beam.

A further object of this invention is to provide a novel image device having means for selecting from a font of characters certain ones and reproducing the selected characters at an extremely rapid rate in a predetermined manner.

A still further object of this invention is to provide a new and novel image device that selects particular portions of an image and reproduces the selected portions in a re-arranged relationship with respect to each other.

A still further object of this invention is to provide a new and novel image device utilizing a font of characters from which a signal is selected that is readily changeable with other fronts to provide a different coding or type face.

A still further object of this invention is to provide an improved image device that will produce a complete message on the face of the tube, at an extremely fast speed, that is the exact image of what a tele-typewriter would print if controlled from the same tape.

In the embodiments of the invention shown, there is provided an electron image device comprising an evacuated elongated envelope having a photo-sensitive cathode mounted in one end of the envelope and in the other end

of the envelope a target electrode that converts electron images into visible images. Intermediate these electrodes are provided various accelerating electrodes to provide acceleration to the electron images. Intermediate the photo-sensitive cathode and the target electrode is provided an apertured electrode. Adjacent the envelope are various coils and yokes for selecting a particular portion of the electrode image from the photo-sensitive cathode, focusing the selected portion in the aperture in the apertured electrode, and positioning this portion as a visible image in a desired manner on the target electrode. This information may then be viewed or photographed, etc.

The novel features which are believed to be characteristic of the invention, are set forth with particularity in the appended claims. The invention itself will best be understood from the following descriptions taken in conjunction with the accompanying drawings wherein like reference characters designate similar elements throughout the several views and in which:

Figure 1 is a sectional view of a new and novel image device constructed in accordance with this invention;

Figure 2 is a view of a mask or matrix which may be used with this invention; and

Figure 3 is a sectional view of a preferred embodiment of a new and novel image device constructed in accordance with this invention.

Referring particularly to Figure 1, there is shown a sectional view of an image device, or tube, **10** comprising an elongated envelope **11** having an exhaust tube **12**. In one end of the elongated envelope **11** is a semi-transparent photo-emissive cathode **14** having a lead-in **15** connected thereto. Any of the conventional photo-cathode materials may be used, an example of which is caesium antimony. When the photo-cathode material is used, the antimony is applied first and then the caesium may be applied in vapor form to the antimony by means of the exhaust **12**.

Inside the elongated envelope **11** is an accelerating electrode **16** having a lead-in **18** connected thereto. The accelerating electrode **16** is held in place within the envelope **11** by means of sealing the lead-in **18** through the envelope **11** and spot welding the electrode and lead-in. Of course other conventional means may be used to support the accelerating electrode **16**. The end of the accelerating electrode **16** that is adjacent the photo-sensitive cathode **14** contains an evaporator electrode **17** to evaporate the caesium vapor as is well known in the art.

Adjacent the other side of accelerating electrode **16** is a baffle, or apertured electrode, **24** that is sealed across the entire tube structure. The apertured electrode **24** has a lead-in **25** connected thereto, and is composed of any conductive material. The single aperture **19** in apertured electrode **24** is substantially centrally located and may be either round, square, or any other desired configuration. The size of aperture **19** may vary as will be explained hereinafter.

On the target side of apertured electrode **24** are other accelerating electrodes **26**, **32**, and **34** having lead-ins **27**, **33**, and **35** respectively. These accelerating electrodes are also spot welded to their respective lead-in connections for support purposes.

In the other end of the elongated envelope **11** is an anode, or target electrode, **36** comprising fluorescent screen with an aluminum backing having a lead-in **37** connected thereto. The anode **36** may be any of the conventional fluorescent screens of either of the long or short persistent type depending upon the operating characteristics that are desired. An example of a short persistent screen is calcium magnesium silicate mixed to produce a desired white light with zinc berylium silicate. An

example of a long persistent screen is a layer of zinc cadmium sulfide over a layer of zinc sulfide. It should be understood that other materials may be used for the fluorescent screen.

Adjacent the portion of the elongated envelope **11** containing the accelerating electrode **16** is a character selection, or deflection, yoke **20** having lead-ins **21** connected thereto. Surrounding the character selection yoke **20**, and the envelope **11**, is a focusing coil **22** having lead-ins **23** connected thereto. The character selection yoke **20** includes coils for both the horizontal and vertical components as is well known in the art.

Surrounding the envelope **11** in the vicinity of accelerating electrodes **26** and **32**, as shown, is a character positioning yoke **28** having conventional leads **29** connected thereto. Surrounding the character positioning yoke **28** is a focusing coil **30** having leads **31** connected thereto. It should be understood that electrostatic, in place of electromagnetic, deflection systems may be used in connection with device **10** as is well known in the art.

The general operation of the device **10** is as follows: when a visible image is directed on the photo-sensitive cathode **14** by means of a light source **13** and the mask of characters **39** (Fig. 2), the image will cause electrons to be emitted from the different areas of the photo-sensitive cathode **14** in proportion to the light reaching the photo-cathode. The entire electron image is accelerated toward the target electrode **36** by means of the accelerating electrodes **16**, **26**, **32**, and **34**. The vast majority of the entire electron image that is accelerated toward the anode **36** will strike the baffle, or apertured electrode, **24** and only those that pass through aperture **19** will reach anode **36** if no other electrical or magnetic forces are applied to the electron stream.

We use the focusing coil **22** to maintain the entire electron image in the same relationship as that produced by cathode **14** so that it will strike either the apertured electrode **24**, or the aperture **19**. In other words, the focusing coil **22** maintains the electron image in focus at the aperture **19** in the same form as when originally produced. The character selection yoke **20** deflects the entire electron image so that only a desired portion of the entire electron image is passed through aperture **19** at a given instant. By varying the currents through the character selection yoke **20** any particular portion of the electron image amy be passed through the aperture **19** while all other portions of the image are eliminated by the conductive properties of apertured electrode **24**.

The focusing coil **30** maintains the selected portion of the electron image, i. e., the portion that passes through aperture **19** in the same relationship throughout the path from the aperture **19** to the anode **36**. The element positioning yoke **28** positions any selected portion of the electron image on the anode **36**. The operation of image device **10**, as well as examples of potentials, will be described more fully hereinafter. A system for operating this type of image device, i. e., feeding signals thereto, is described in an application of Charles J. Young, Serial Number 187,879 filed October 2, 1950, now U. S. Patent No. 2,807,663, and assigned to the same assignee as the present invention.

Referring now to Figure 2, there is shown a mask **39** that is adapted to be used in connection with this invention by focusing a light image **13** (see Fig. 1) of this mask **39** on the photo-emissive cathode **14**. As shown, the mask **39** includes as characters the entire alphabet, the numbers 0–9, and other standard symbols. The characters, numbers and symbols may be substantially transparent so that light from source **13** will pass therethrough. When a light image of a mask **39** of this type is projected on the photo-emissive cathode **14**, the cathode **14** produces an electron image representative of the light image of the entire mask **39**. The accelerating electrode **16** accelerates this electron image toward the baffle,

or apertured electrode **24**. The electron image is maintained throughout the path from the photo-cathode **14** to the apertured electrode **24** by means of focusing coil **22**. In other words, the electron image is maintained in the same form as when originally produced.

The deflection, or selection, yoke **20** selects the electron image of any particular character, from the electron image of the mask **39**, and locates the selected electron image for the particular character in the aperture **19** in apertured electrode **24**. By changing the currents through the selection yoke **20**, any of the characters of the electron image of the mask **39** are focused into the aperture **19**. This selection involves both horizontal and vertical deflection of the entire image formed by the electron beam. The selection of different characters from the electron image can occur at an extremely fast rate of speed. The only limitation upon the rate of changing from one selected character to another is the time element required for changing the current through the selection yoke **20**.

Once a particular character is selected, and the electron image of this character is focused into aperture **19**, the focusing coil **30** maintains the electron arrangement of this selected character between the apertured electrode **24** and the anode, or target electrode, **36**. This selected character is accelerated toward the target electrode **36** by means of the potentials applied to the accelerating electrodes **26**, **32**, and **34**.

When it is desired to place the selected characters in a particular arrangement, currents are applied to the positioning yoke **28** to position the area of impact of the selected electron images on the target electrode **36**. Thus, by proper co-ordination between the currents applied to the selection yoke **20**, and the positioning yoke **28**, material may be located on the target electrode **36** in any form desired.

Electrode **24** may be pulsed to a negative potential with respect to cathode **14** if it is desired to bias off the image. This, for example, may be done during the time the character is being moved. There are other applications of the tube **10** where this may be required.

When the selected portion of the electron image passes through device **10**, it spirals to some extent. One method of correcting this in the final image is to twist the mask **39** so that the original light image is twisted but the final image is properly arranged.

When the information transmitted is to be observed in a visual manner, a long persistence target screen is desirable. However, in order to utilize the potentially high speed of the device, a relatively short persistence screen is utilized. One method of utilizing the fast response of the device is to photograph each frame of information during the time when it is being sent through device **10**.

A very excellent method of transforming teletyped information into written information is provided. When information is in the form of a tele-typewriter tape, each line on the tape, i. e., each character, may be adjusted to develop particular currents in both the selection and position yokes so that this information can be quickly recorded on a photographic film as written information. When the pattern of perforation for each character has been altered, according to a code, the message can still be decoded in the process of presentation by substituting an appropriate mask, i. e., a mask with a different arrangement of the characters. In other words, any change in the perforation code can be matched by a change in the mask to present decoded messages.

Referring now to Figure 3, there is shown a cross-sectional view of a preferred embodiment of this invention comprising an elongated envelope **43** having an expanded end **43'**. In the smaller end of the elongated envelope **43** there is a photo-cathode **45**. Extending from adjacent the photo-cathode **45**, along the envelope walls, there is an accelerating electrode **46**. Connected to ac-

celerating electrode 46 is a conductor 44 that extends along the envelope 43 in the conventional manner. The accelerating electrode 46 is held in place by conventional means such as springs 56 as shown. Adjacent the other end of accelerating electrode 46 there is a baffle, or apertured electrode, 47 having a single aperture 48 therein.

Adjacent the apertured electrode 47 is a cylindrical decelerating electrode 49. Adjacent the decelerating electrode 49 is an accelerating electrode 50 having a cone shaped end. The electrodes 49 and 50 also have conventional lead-ins and supports. The reason that it is preferred to operate electrode 49 as a decelerating electrode is to prevent secondary emission from edge of aperture 48 in the apertured electrode 47. When this occurs there is a halo effect around the characters on the target 51. The cone 50 opens into the expanded portion 43' of the envelope 43. This expanded portion 43' permits the use of a large size screen. On the inner surface of the expanded portion 43' of the envelope 43 is an aluminized fluorescent screen 51. The fluorescent screen 51 having an aluminum backing has a conventional lead-in 58 connected thereto. The screen 51 may be applied to the end of envelope 43 by conventional methods.

One method of enlarging the size of the image on the target 51 is by changing the position of the focusing coil as is well known in the art. Another method is to project larger size light images through the device.

Surrounding the photo-cathode end of envelope 43 is a character selection, or deflection, yoke 52 as shown. Surrounding the selection yoke 52, is a focusing coil 53. Surrounding the envelope 43, adjacent the expanded end 43' is a character positioning, or deflection, yoke 54. Surrounding the character positioning yoke 54 is a second focusing coil 55.

The currents that are applied to the various yokes to select a particular character and position the selected character will depend upon several factors as the size of envelope 43, the potentials applied to the various electrodes, etc., therefore specific examples will not be given. An example of the various electrode potentials for the device shown in Figure 3 is as follows: assuming the photo-cathode 45 is at ground potential; apertured disk 47, and the accelerating electrode 46, could be at a potential of about 150 volts positive. The decelerating electrode 49 could be approximately 60 volts positive since it is preferred that this accelerating electrode have a potential that is less than the potential of apertured electrode 47, in order to prevent secondary emission from the edge of the aperture 48 in the apertured electrode 47. The accelerating electrode and cone 50 may have a potential of 5,000 volts positive and the screen may have a potential of 20,000 volts positive. These potentials are not intended to be limiting but are shown merely to give one example of successful operating conditions.

The size of aperture 48 is preferably only slightly larger than the size of an electron image of a particular character of the matrix 39. It has been found that aperture sizes of ⅛ inch in diameter operate very satisfactorily. The aperture may also be of some configuration other than circular, and would intentionally be so designed for particular matrices.

For certain types of operation it may be desired to have a larger sized aperture 48. When this is done pulses may be applied to apertured electrode 47 to result in various disconnected images of particular information similar to the frames of a moving picture. For applications of this sort an aperture 48 size of ¼ inch in diameter is satisfactory.

The operation of the device shown in Figure 3 is similar to the operation of the device shown in Figure 1. Generally the operation is as follows: a light image of transparent characters on the matrix 39 is projected onto photo-cathode 45 by means of light source 13 and a portion of the electron image formed by the light image is selected by means of the current through the selection coil 52. The selected portion is passed through the aperture 48 in apertured electrode 47 and is positioned on the target electrode 51 by means of the current through the positioning coil 54.

While there have been described and illustrated specific embodiments of the invention, it will be obvious that various changes and modifications may be made therein without departing from the field of the invention which should be limited only by the scope of the appended claims.

We claim:

1. An image device comprising an elongated envelope, means mounted within one end of said envelope for producing an electron image of light radiation from an object, means mounted within the other end of said envelope for producing a visible image representative of said electron image, said last named means being substantially larger than said first named means, an apertured electrode intermediate said first mentioned means and said second mentioned means, focusing means for focusing said electron image, selection means for selecting a portion of said electron image and projecting said portion through said apertured electrode, focusing means for focusing said selected portion, and positioning means for positioning said selected portion on said second mentioned means.

2. An image device comprising an elongated envelope, a photo-sensitive cathode within one end of said envelope and adapted to release an electron image, a target electrode at the other end of said envelope, said target electrode being substantially larger in electron receiving area than said photo-sensitive cathode is in electron emitting area, an apertured electrode intermediate said ends of said envelope, means adjacent said one end of said envelope for selecting a portion of said electron image and directing said portion through said apertured electrode, and deflecting means adjacent said other end of said envelope for deflecting said selected portion on to selected areas of said target electrode.

3. An image device comprising an elongated envelope, a photo-sensitive cathode within said envelope adapted to release an electron image in one end of said envelope, a target electrode at the other end of said envelope, said target electrode being substantially larger than said photo-sensitive cathode, an apertured electrode intermediate said ends of said envelope, means adjacent said one end of said envelope for selecting a portion of said electron image and directing said portion through said apertured electrode, and deflecting means adjacent said other end of said envelope for deflecting said selected portion on to said target electrode.

4. An image device comprising an elongated envelope, a photo-sensitive cathode adapted to release an entire electron image in one end of said envelope, a target electrode at the other end of said envelope, said target electrode being substantially larger than said photo-sensitive cathode, an apertured electrode intermediate said ends of said envelope, said apertured electrode being substantially the same size as said photo-sensitive cathode, deflection coils adjacent said one end of said envelope for selecting a portion of said electron image and deflecting said portion only through said apertured electrode, and deflection coils adjacent said other end of said envelope for positioning said selected portion on said target electrode.

5. An image device comprising, an elongated envelope, a photo-sensitive cathode upon which an optical image may be projected and from which an electron image may be derived in one end of said envelope, a target electrode upon which an electron image may be projected and from which an optical image may be derived in the other end of said envelope, an electrode having an aperture therein intermediate said ends, means within said envelope for accelerating electrons from said cathode

to said target electrode, a focusing coil adjacent said one end of said envelope for focusing said electron image, a selection coil adjacent said one end of said envelope for selecting a portion of said electron image and deflecting said portion only through said aperture, a focusing coil adjacent said other end of said envelope for focusing said selected electron image, a positioning coil adjacent said other end of said envelope for positioning said selected electron image on said target electrode, means connected to said coils for varying said selected portion and said position of said selected portion on said target electrode, and said apertured electrode being adapted to have a potential applied thereto that is negative with respect to the potential applied to said cathode whereby said electron image is cut off from said target electrode.

6. An image device, comprising an elongated envelope having an expanded end, a target electrode in said expanded end, a photo-emissive cathode in the other end of said envelope, an apertured electrode having a single aperture therein intermediate said cathode and said target electrode, a first accelerating cylinder intermediate said cathode and said apertured electrode, a second accelerating cylinder intermediate said apertured electrode and said target electrode, a third electron cylinder and cone intermediate said second cylinder and said target electrode, a selection coil around the cathode end of said envelope, a focusing coil around said selection coil, a positioning coil around said envelope adjacent said expanded end, and a focusing coil around said positioning coil.

7. An image device as in claim 6 wherein said cathode and said apertured electrode are substantially the same size and extend across said envelope, and said target electrode is larger in size than said cathode and extends across said expanded end of said envelope.

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