June 7, 1960 J. T. McNANEY 2,939,982

CATHODE RAY TUBE APPARATUS

Filed Oct. 2, 1957 3 Sheets-Sheet 1

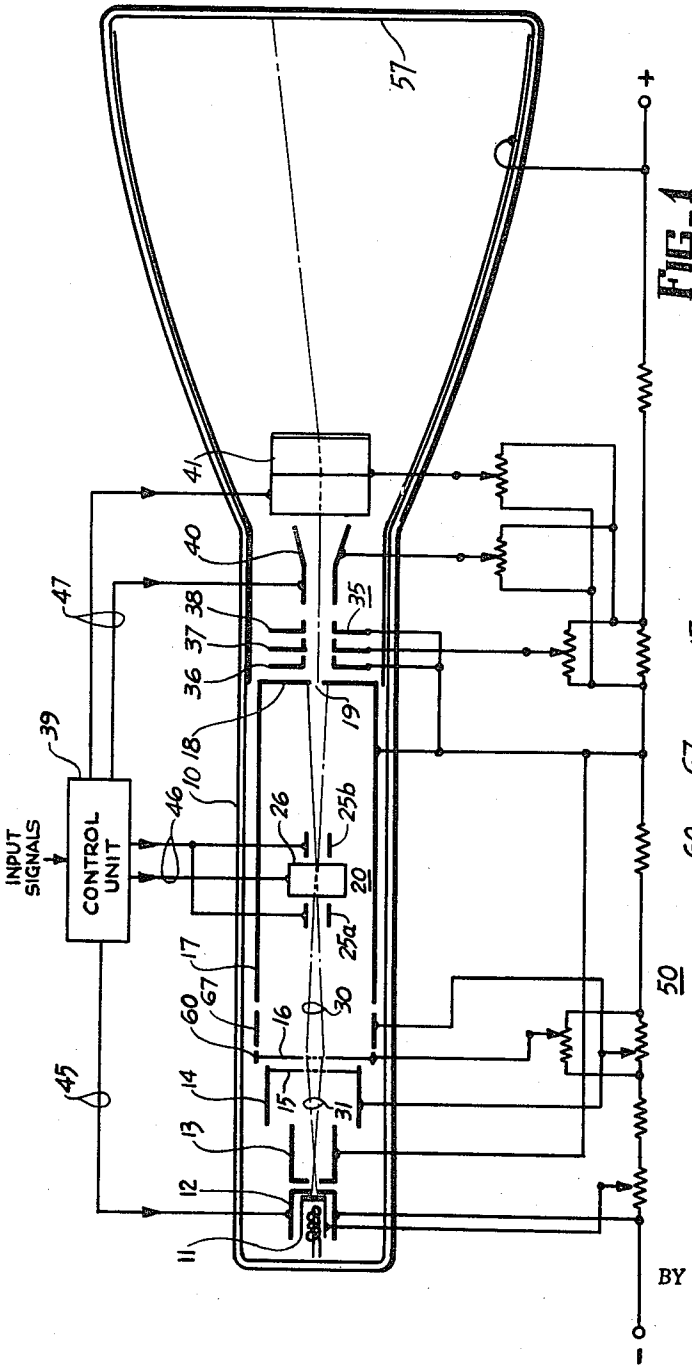


FIG_1

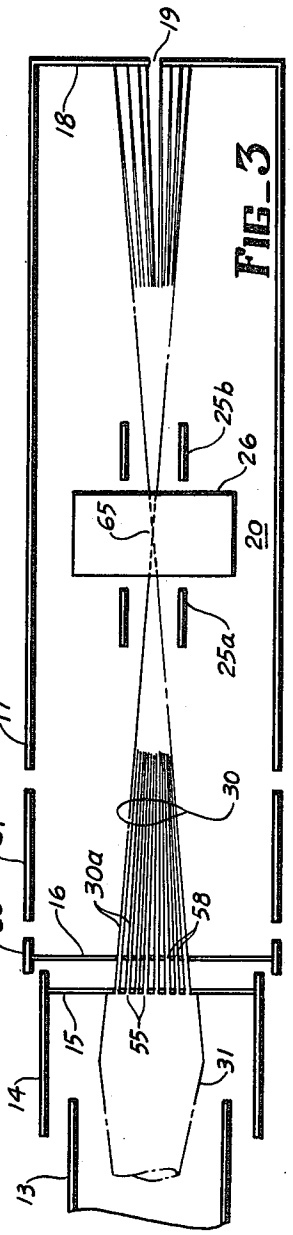


FIG_3

INVENTOR.
JOSEPH T. McNANEY.

Egon W. Mueller

ATTORNEY.

June 7, 1960 J. T. McNANEY 2,939,982

CATHODE RAY TUBE APPARATUS

Filed Oct. 2, 1957 3 Sheets-Sheet 2

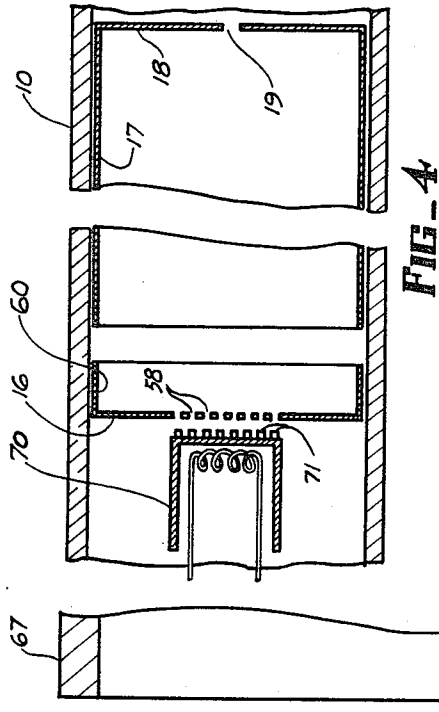


FIG-4

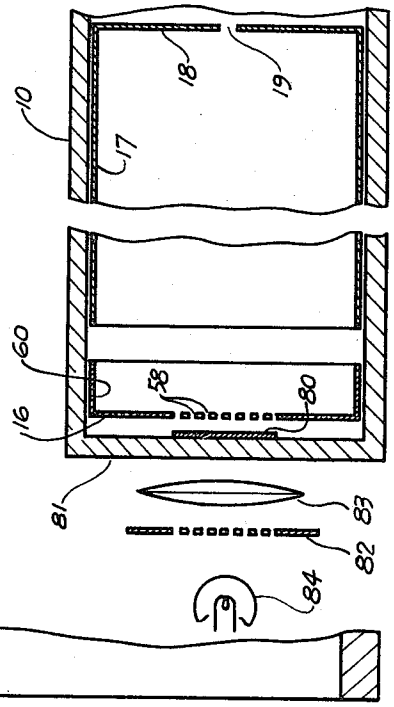


FIG-5

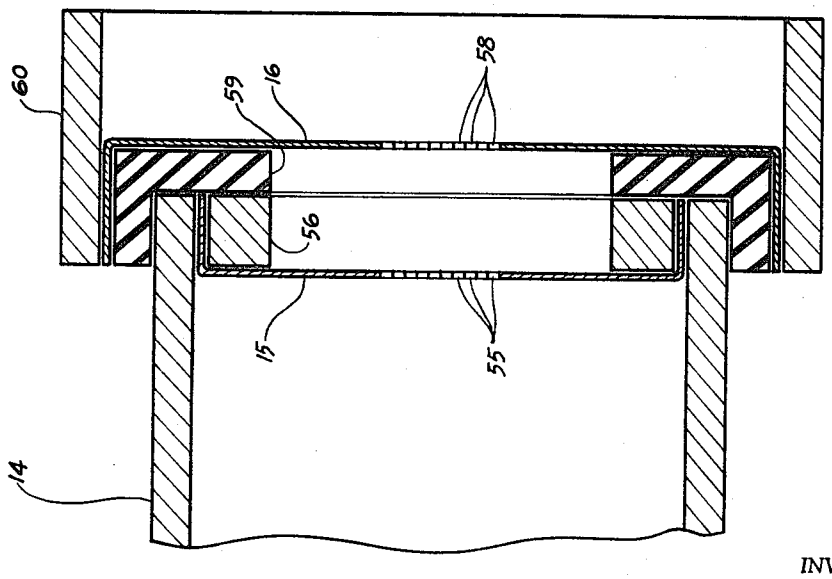


FIG-2

INVENTOR.
JOSEPH T. McNANEY.

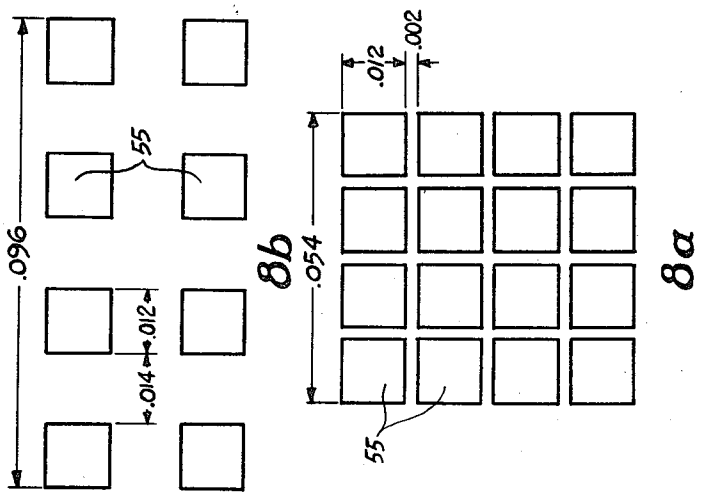
BY Egon W. Mueller

ATTORNEY.

June 7, 1960 J. T. McNANEY 2,939,982

CATHODE RAY TUBE APPARATUS

Filed Oct. 2, 1957 3 Sheets-Sheet 3



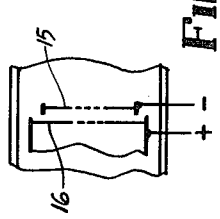


FIG_1a

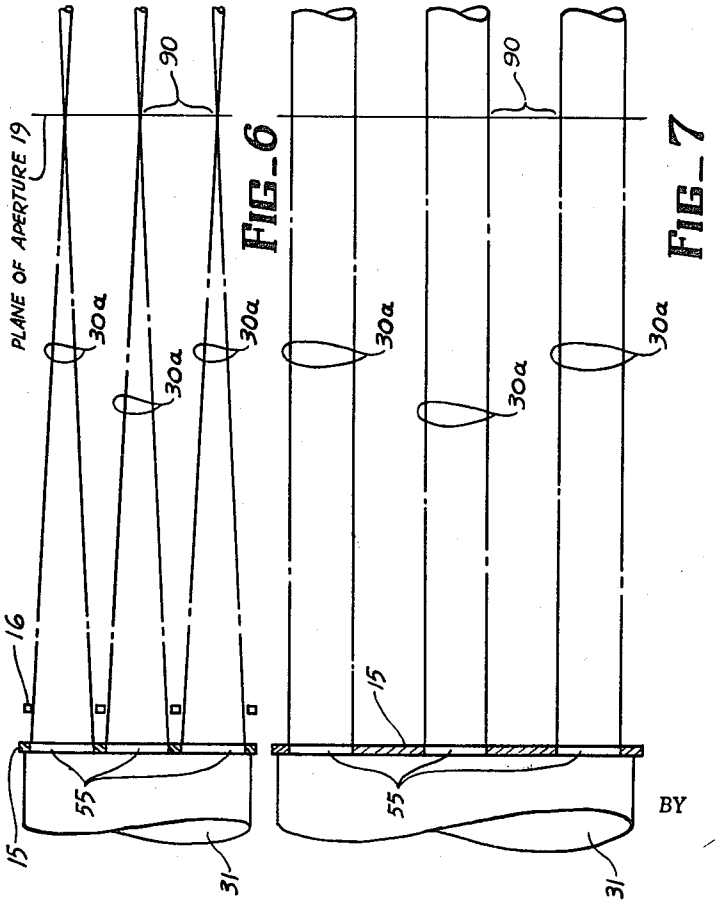
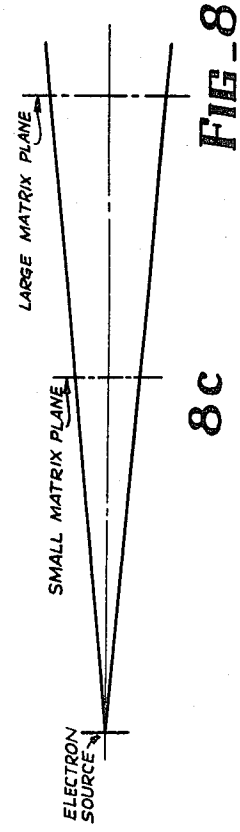


FIG_6

FIG_7



8c

FIG_8

INVENTOR.
JOSEPH T. McNANEY

BY

ATTORNEY.

United States Patent Office

2,939,982

Patented June 7, 1960

2,939,982

CATHODE RAY TUBE APPARATUS

Joseph T. McNaney, La Mesa, Calif., assignor to General Dynamics Corporation, Rochester, N.Y., a corporation of Delaware

Filed Oct. 2, 1957, Ser. No. 687,798

14 Claims. (Cl. 313—86)

This invention relates to cathode ray tube apparatus in which a shaped electron beam is generated for displaying or writing characters upon the screen of the tube. More particularly, the invention relates to improved apparatus to control the shaped beam.

Character writing cathode ray tubes of the type to which the present improvements are directed, have been developed and are described, for example, in Patent No. 2,761,988, issued to Joseph T. McNaney on September 4, 1956, entitled "Cathode Ray Apparatus." The cathode ray tube of this patent comprises essentially an electron gun for generating and projecting an electron beam through a thin disk or matrix having character shaped openings which thereby shape the beam cross section accordingly. A plate may be positioned in the path of the character shaped beams. This plate presents a beam selection aperture. A deflection system may be provided intermediate the plate and the matrix for directing different ones of the character shaped beams through the aperture for impingement upon a target or luminescent viewing screen. A positioning deflection system may be located between the target and apertured plate to direct the selected beam to different desired locations on the target.

In the cathode ray tubes of the type described, the center to center spacings of characters or cutout portions in the beam shaping means or matrix, and the non-perforated areas between adjacent characters are desirably kept to the smallest physical dimensions possible in order to utilize more efficiently the electrons available in the beam directed at the matrix. It is additionally desirable to further minimize the space requirements of a given number of characters in the matrix to reduce the undesirable effects of electron lens aberrations. The practical limitations with regards to the minimization of matrix dimensions are in the character selection capabilities of the selection system and the circuitry used with the tube. The present invention substantially overcomes the aforestated difficulties and achieves the desired results in providing new and improved means to aid in character selection.

In addition to the stated objects and advantages, it is an object of the invention to provide an improvement in character selection and projection within a cathode ray tube utilizing a shaped electron beam.

It is also an object of the invention to reduce to a minimum matrix dimensions for unused space intermediate adjacent characters or cutout portions which aids to reduce the effects of lens aberrations making more efficient use of the electrons in the initial beam, and thereby also reduces the overall length of the character beam-forming gun assembly.

In accordance with the invention, there is employed within the cathode ray tube a plurality of electron lenses, one for each character opening in the matrix, which lenses are supported in electro-optical cooperating relationship with the matrix. The effect of an independent lens upon each one of the character shaped beams extruded from the beam through the matrix will permit independent

change of the angle of convergence and focusing for each of the respective beams. This independent change is further independent of electron lens effects affecting the convergence angle of the entire bundle of individual beams as a whole. Each character shaped beam is, thereby, made to cross over at a desired plane at the aperture plate. The individual shaped beam is therefore at minimal cross section at the plate when directed through the selection aperture for presentation on the viewing screen. Since the ratio of beam width to space between beams is increased, and since it is possible to decrease the size of the selection aperture by virtue of the smaller beam cross section at the aperture plane, the space between the character shaped openings in the matrix may be reduced, thereby, permitting the matrix area, for a given number of characters, to be made smaller.

It is also in accordance with the invention to provide a system of individual shaped beam control lenses which may desirably be adapted to operate with thermionic emissive or photo emissive cathode sources of character shaped beams. Beams of predetermined cross section emanating from thermionic or photo emissive surfaces will be provided, respectively, with like individual lens apertures for each character cross section which allow the angle of convergence of each of such beams to be controlled independently of an overall lens action common to the entire array of beams.

Generally, the present invention comprises a cathode ray tube which includes within an evacuated vessel, a target or screen capable of responding to electrons, a source of shaped electron beams directed toward the target and improved means for effecting desired convergence of each of the beams.

Other objects and advantages will appear from the following description of the invention, reference being had to the accompanying drawings, in which:

Figure 1 is a schematic representation of a cathode ray tube embodying the invention;

Figure 1*a* is a fragmentary view showing an additional embodiment of Figure 1;

Figure 2 is an enlarged detail portion of the invention shown in Figure 1;

Figure 3 is a schematic diagram showing the operating characteristics of the invention;

Figure 4 is a schematic of an additional embodiment of the invention;

Figure 5 is a schematic of another embodiment of the invention;

Figure 6 is a diagram showing desired operating characteristics utilizing the invention;

Figure 7 is a diagram showing the operating characteristics without the invention;

Figures 8*a*, *b*, and *c* diagrammatically display desired advantages of the invention.

Referring to Figure 1, there is shown a cathode ray tube with exemplary operating circuits.

The cathode ray tube, which, since it utilizes shaped electron beams, may also be referred to as a shaped beam tube, is, in accordance with well known manufacture, provided with an evacuated envelope **10**. Envelope **10** may be constructed of plastic, glass, metal or the like.

Positioned at or adjacent one end of envelope **10** is a beam generating means. The beam generating means may take the form of various embodiments such as the thermionic cathodes or electron source **11** shown in Figure 1, or the preformed emitter cathode or source **70**, **71**, of Figure 4, or the photo emissive emitter or source **80** as shown in Figure 5. It is a necessary part of the invention to form individually shaped electron beams, the manner of forming them may be effected, if desired, by utilizing one of the stated examples. For purposes

of exemplification, the detail description of the invention will utilize the embodiment of Figure 1.

The shaped beam tube as exemplified in Figure 1, shows the electron source **11** generating an electron beam **31** controlled by control grid **12**. The beam **31** may be accelerated by an accelerating anode **13** toward a first anode **14**. First anode **14** may, for example, carry a beam shaping means, shown as a matrix **15** which, in turn, present a plurality of cutout portions or character shapes **55** as detailed in Figures 2 and 3. The beam shaping means, interposed in the path of the beam, causes the beam to be shaped into cross sectional shapes corresponding with that of the cutout portions **55**. The resultant electron beam includes a plurality of character shaped beams **30**. These character shaped beams are crossed over at point **65** by a first convergence means which includes the lens action of anodes **13** and **14**.

The shaped beams **30** are next acted upon by a multiple lens member **16** or second convergence means. Lens member **16** is positioned within envelope **10** in general axial alignment with the aforementioned beam influencing apparatus and is spaced apart from and parallel to the beam shaping means **15**. Lens member **16** has formed therethrough a plurality of openings or lens elements **58**, as detailed in Figures 2 and 3, each large enough in cross section to accept and transmit therethrough a single shaped beam. Each of the lens elements **58** effects a predetermined converging and focusing action upon either a portion of the electron beam applicable to a subsequently shaped beam through portion **55**, or to one of the shaped beams **30**. Another way of stating this is that one lens element **58** is provided for each cutout portion **55**, with the same predetermined lens element **58** being used with the portion of the beam, shaped or unshaped as applies to that lens element's applicable cutout portion **55**. The invention contemplates the individual lensing of the finally shaped beams at a desired point to cross over, therefore, the lens elements, which effect such action, may act on the unshaped beam **31**, as shown in Figure 1*a*, prior to shaping, or may act subsequent to shaping of individual cross sections in the beam as exemplified in Figures 1, 2, 3, 4, 5 and 6. As the lens elements should either pass enough of the electron beam to illuminate one desired cutout portion, or accept therethrough an entire shaped beam, it may be desirable to impart a predetermined cross sectional area to the cross sections of the beam generated by the cutout portions and having the lens elements with a cross sectional area exceeding that of the predetermined area.

Additional elements to complete the operative electro optical system of the cathode ray tube include a second anode **67** and a third anode **17** forming a third convergence means, both capable of accelerating shaped beam **30** and for effecting cross over of all the shaped beams at point **65**. Within anode **17** and along the path of beam **30** is positioned a first deflection means **20**, exemplified as electrostatic, and, including vertical deflection plates **25***a* and *b* and horizontal deflection plates **26**. Plates **25***a* and *b*, **26** may be utilized to effect predetermined deflection of the composite shaped beam **30**.

Positioned in the path of the shaped beam **30**, and if desired, there may be attached to an extremity of anode **17** an apertured plate **18** presenting an aperture **19** generally along the longitudinal axis of the electro optical system hereinabove described, which aperture **19** is capable of passing one complete shaped beam selected therethrough by the deflection means **20**. It is at the center of the aperture along the axis that the desired convergence and focusing of the individual shaped beams comprising the electron beam **30** are to be focused to a point and cross over effected by the lens elements **58**. The desired shaped beam passed by the aperture **19** is then focused by a lens exemplified as an electrostatic lens **35** and comprising anode elements **36, 37, 38**, which, acting together will effect the desired additional lensing of a selected shaped beam imaging the cross section thereof at a desired size upon the target **57**. A second deflection means exemplified by electrostatic deflection plates **40** and **41**, may be utilized to effect horizontal and vertical deflection of the shaped beam to desired positions of that beam upon the target.

An exemplary circuit **50** capable of operating the tube is shown. As it is desired to effect preferably electrostatic lensing of the electron beam **31**, anode **13** may be maintained at a potential in excess of anode **14** thereby creating an electrostatic field therebetween which will converge the divergent or scattering electron beam **31**. The further effect of lens member **16** which is preferably kept at a potential more positive than that of beam shaping means **15** will cause the individual lens elements **58** to act upon the individual shaped beams of beam **30** to thereby effect the desired imaging and cross over of the individual beams at a point preferably along the axis in the plane of aperture **19** of the apertured plate **18**. Independently of the convergence of the overall electron beam **31, 30** exerted by the convergence effected by anodes **13** and **14** and the further convergence effected by the electrostatic field generated by anodes **67** and **17**. While in the exemplification, the shaping means or matrix **15** is shown at a potential, it should be understood that the matrix may, if desired, be maintained at a neutral potential with respect to the adjacent elements or "floating," it not being necessary to the operation of the invention to have the matrix at a potential level, but if it is as shown, the matrix should be at a potential less than that of the lens member.

As shown in the enlarged view in Figure 3, the electron beam **31** after being shaped into individually shaped beams **30***a* all part of shaped beam **30**, through matrix **15** is lensed by the lens member **16** into an overall bundle whereby the electron beam **30***a* as a whole, is converged onto the axis at approximately a point **65**, to cross over, intermediate deflection plates **25***a* and **25***b* of the first deflection means **20**. Under the influence of the first deflection means **20** the entire composite bundle of beams is deflected to permit one of the desired beams to be positioned through aperture **19** in apertured plate **18**. The convergence of the entire beam **31** is effected by the anodes **13** and **14**, which provide the electrostatic field to converge the divergent beam **31**. There is, in addition, a further convergence effected by the anodes **67** and **17**.

The effect of the lens member **16** upon the individually shaped beams may best be illustrated by reference to Figures 6 and 7. There is shown in Figure 7 the individually shaped beams **30***a* resulting from the illumination by beam **31** of the cutout portions or character shapes **55** through the matrix **15**. It should be noted that these shaped beams **30***a* follow a substantially unaltered path with the entire bundle of shaped beams **30** and will, in the plane of the aperture **19**, as shown in Figure 7, be of a size approximating that of their illuminated size. The effect, therefore, of lens member **16** as shown in Figure 6, is to reduce the size of the shaped beam to a point and to cross over at the plane of the aperture for subsequent imaging thereof onto the target **57**, thereby retaining a like amount of spacing **90** intermediate the shaped beams for selection tolerance of adjacent characters. It is this spacing **90** which is necessary to give a sufficient working parameter or tolerance for the first deflection means **20**.

It can therefore be seen that the closer spacing of the characters on the matrix as illustrated in Figure 8 can be achieved while still retaining the desired spacing **90** necessary to permit operation of the deflection system **20**. Figure 8*a* shows a desired matrix construction in which the cut out portions **55** may be spaced considerably closer than those shown of a conventional matrix, Figure 8*b*. Figure 8*c* shows the additional advantage achievable by

the use of the lens member 16 in that a smaller matrix may be placed at the small matrix plane, thereby considerably shortening the length of a normal tube in which a matrix similar to that of Figure 8*b* normally must be placed at the large matrix plane of Figure 8*c*. It is therefore possible through the utilization of the instant invention to better utilize the electron beam from the electron source and to shorten considerably the electro optical system of the shaped beam tube.

As explained in the aforedescribed Figures 6, 7 and 8, the utilization of a lens member 16 presenting the multiple lens elements 58, effects for example, a matrix having .012 inch high character openings 55 in matrix 15 which may be spaced on .014 inch centers for a given selection tolerance, whereas the system prior to the present invention required, as shown in Figure 8*b*, a center to center spacing of .026 inch with .012 inch high characters. Therefore, the result, in this example, is a 1.85–1 reduction in matrix size. The unused spacing intermediate the characters on the matrix 15 is reduced by a factor of 9.5 which, of course, results in a similar saving of beam current by a like amount. Using the exemplary measurements stated above, there may result a reduction in the length of the electro optical structure intermediate the beam generating means and the apertured plate 18 of approximately 1.85–1.

A desired structure exemplified in Figure 1 may be built in conformance with that of Figure 2, in which, the matrix 15 may be retained in a ring 14 by another ring 56 and have positioned thereagainst an insulating ring 59 designed to carry and compress the lens shaping member 16 against ring 60. It should be borne in mind, however, that this is merely a desired exemplified construction and many other mechanical positioning devices can be used and still be within the ambit of this invention.

It is also possible, as has been stated heretofore, to utilize a beam generating means in which the shaped electron beams are generated through the use of a dispenser type thermionic cathode 70, which presents upon its emitting surface discrete pre-character shaped emitters 71 for emitting a shaped electron beam having the desired plurality of shapes contained thereon. In an embodiment such as shown in Figure 4, the lens member 16 may be positioned in front of the shaped beam emitters 71 so that the individual lens elements 58 will effect the desired lensing action upon the individually shaped beams as heretofore described, in connection with Figure 1. The further operation of the embodiment of Figure 4 of course, will then be similar to that of Figure 1.

Figure 5 shows still another embodiment in which a photo emissive cathode 80 is disposed upon an optically clear section 81 of the envelope 10. A light transparent matrix 82 has formed therein the desired plurality of character shapes, which, following illumination by a light source 84, are projected by a lens 83 onto the photo emissive cathode 80. Photo emissive cathode 80 then translates the light radiation patterns into current beam shapes for the production of an electron beam similar to electron beam 30, including the desired plurality of shaped electron beam cross sections. As previously stated then, the lens member 16 provides the individual lens elements 58 for each of the desired electron beam shapes emitted by the emitter 80. The utilization of the shaped beam following the action thereon of lens member 16 may be similar to that of Figure 1.

Reverting to Figure 1, in operation of that structure, there are received input signals by the control unit 39. These are relayed by appropriate leads 45, 46 and 47 to, respectively, the control grid 12, first deflection means 20, and the second deflection means 40, 41. The control grid 12 may be used to effect a blanking action on the tube following the presentation of an individual character upon target 57, if desired. As the electron beam is emitted by cathode 11 through the grid aperture of control grid 12, it is accelerated by anode 13 and intermediate anode 13 and subsequent anode 14 is converged by the electrostatic field existing between the two anodes. Beam 31 then illuminates the character openings 55 in the beam shaping member or matrix 15. The shaped beams 30 thereupon pass through lens elements 58 in lens member 16 and have their individually shaped cross sections imaged at the plane of aperture 19, the overall shaped beam 30, as well as the unshaped beam 31, is first acted on by the electrostatic converging field set up by anodes 13 and 14 and next acted on by the electrostatic convergence field set up by anodes 67 and 17 to effect cross over of all beams 30*a* at approximately a point 65 intermediate the first deflection means 20. While the convergence of all the shaped beams to point 65 may be effected solely by the lens action of anodes 13 and 14 or the lens action of anodes 67 and 17, the structure of Figure 1 utilizes the lens action of both convergence means to effect the desired cross over. The first deflection means 20, energized by control unit 39 through its leads 46, effects a deflection of the entire shaped beams 30 at a minimal cross section area of that beam to position a desired character at aperture 19 of apertured plate 18. The character shapes, or individually shaped beam 30*a*, however, retaining its imaging at the plane of the aperture 19 or at the apertured plate 18. The desired character is, thereby, selected through the aperture 19 for subsequent focusing and lensing thereof by the lens 35, imaging that cross section at the plane of the target 57. The shaped beam, following the lensing action of the lens 35, is deflected to its final position on the target 57 by the second deflection means 40, 41 energized through its leads 46 from the control unit 39.

The particular embodiments of the invention illustrated and described herein are illustrative only, and the invention includes such other modifications and equivalents as may readily occur to those skilled in the art, within the scope of the appended claims.

I claim:

1. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, beam shaping means including shaped cutout portions interposed in the path of the beam for shaping the electron beam through the cutout portions into desired cross sections, a multiple lens member positioned in the path of the beam parallel to and in spaced apart relation with the beam shaping means, said lens member presenting a plurality of lens elements for converging and focusing portions of the electron beam applicable to said cutout portions, said lens member being positioned intermediate the beam shaping means and the target, a first deflection means for deflecting the cross sections, and an apertured plate having an aperture, said first deflection means being adapted to cause selection of one of said cross sections through said aperture for impingement thereof onto said target.

2. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, beam shaping means including shaped cutout portions interposed in the path of the beam for shaping the electron beam through the cutout portions into desired cross sections, a multiple lens member positioned in the path of the beam parallel to and in spaced apart relation with the beam shaping means, said lens member presenting a plurality of lens elements for converging and focusing portions of the electron beam applicable to said cutout portions, said lens member being positioned intermediate the beam generating means and

the beam shaping means, a first deflection means for deflecting the cross sections, and an apertured plate having an aperture, each of said lens elements being adapted to cause convergence of the cross section imparted to the beam by respective ones of said cutout portions to a point and cross over at the apertured plate, said first deflection means being adapted to cause selection of one of said cross sections through said aperture for impingement thereof onto said target.

3. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means including a thermionic emissive cathode positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, beam shaping means including shaped cutout portions interposed in the path of the beam for shaping the electron beam through the cutout portions into desired cross sections, a multiple lens member positioned in the path of the beam parallel to and in spaced apart relation with the beam shaping means intermediate beam generating means and the shaping means, said lens member presenting a plurality of lens elements for converging and focusing portions of the electron beam applicable to said cutout portions, a first deflection means positioned intermediate the beam shaping member and the target for deflecting the cross sections, and an apertured plate having an aperture positioned intermediate the first deflection means and the target, said first deflection means being adapted to cause selection of one of said cross sections through said aperture for impingement thereof onto said target.

4. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means including a thermionic cathode positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, said cathode presenting beam shaping means for shaping the electron beam into desired cross sections, a multiple lens member positioned in the path of the beam parallel to and in spaced apart relation with the beam shaping means intermediate the shaping means and the target, said lens member presenting a plurality of lens elements for converging and focusing portions of the electron beam applicable to said cross sections, a first deflection means positioned intermediate the lens member and the target for deflecting the cross sections, and an apertured plate having an aperture positioned intermediate the first deflection means and the target, said first deflection means being adapted to cause selection of one of said cross sections through said aperture for impingement thereof onto said target.

5. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, beam shaping means including shaped cutout portions interposed in the path of the beam for shaping the electron beam through the cutout portions into desired cross sections, each of the cutout portions having a predetermined cross sectional area, a multiple lens member positioned in the path of the beam parallel to and in spaced apart relation with the beam shaping means intermediate the shaping means and the target, said lens member presenting a plurality of lens elements for converging and focusing portions of the electron beam applicable to said cutout portions, each of said lens elements having a cross sectional area exceeding the predetermined area, a first deflection means positioned intermediate the lens member and the target for deflecting the cross sections, and an apertured plate having an aperture positioned intermediate the first deflection means and the target, said first deflection means being adapted to cause selection of one of said cross sections through said aperture for impingement thereof onto said target.

6. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, beam shaping means including shaped cutout portions interposed in the path of the beam for shaping the electron beam through the cutout portions into desired cross sections, a multiple lens member positioned in the path of the beam parallel to and in spaced apart relation with the beam shaping means intermediate the shaping means and the target, said lens member presenting a plurality of lens elements for converging and focusing portions of the electron beam applicable to said cutout portions, a first deflection means positioned intermediate the lens member and the target for deflecting the cross sections, convergence means for converging and focusing the electron beam to a point and cross over at the first deflection means, an apertured plate having an aperture positioned intermediate the first deflection means and the target, said first deflection means being adapted to cause selection of one of said cross sections through said aperture for impingement thereof onto said target, each of said lens elements effecting convergence of each of the cross sections to a point and cross over at the apertured plate, a first source of potential having a predetermined potential, said first source of potential being applied to said lens member, a second source of potential having a potential less than said predetermined potential, said second source of potential being applied to said beam shaping means, whereby said lens member through its lens elements effects desired convergence of the cross sections at the apertured plate.

7. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means including a photocathode capable of responding to light images projected thereupon from without the envelope, positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, said photocathode producing the electron beam shaped into desired cross sections, a multiple lens member positioned in the path of the beam parallel to and in spaced apart relation with the photocathode intermediate the photocathode and the target, said lens member presenting a plurality of lens elements for converging and focusing portions of the electron beam applicable to said cross sections, a first deflection means positioned intermediate the lens member and the target for deflecting the cross sections, and an apertured plate having an aperture positioned intermediate the first deflection means and the target, said first deflection means being adapted to cause selection of one of said cross sections through said aperture for impingement thereof onto said target.

8. A shaped beam tube in combination with a beam shaping means for shaping an electron beam into desired cross sections, comprising within an evacuated envelope, a beam generating means positioned at one end of the envelope for generating and projecting said electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, a multiple lens member positioned in the path of the beam, said lens member presenting a plurality of lens elements for converging and focusing portions of the electron beam applicable to said cross sections, a first deflection means disposed about the electron beam shaped into the cross sections for deflecting the cross sections, and an apertured plate having an aperture positioned intermediate the first deflection means and the target, said first deflection means being adapted to cause selection of one of said cross sections through said aperture for impingement thereof onto said target.

9. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, beam shaping means for intercepting and simultaneously shaping said electron beam into a plurality of desired cross sections, each of said cross sections having a shape distinct from the other of said plurality of cross sections, deflection means for deflecting said plurality of cross sectional beams, means having an aperture therein, said deflection means being adapted to cause selection of one of said cross sections through said apertured means for impingement thereof onto said target, a first convergence means for causing said plurality of cross sections to cross over at the center of deflection of said deflection means, a second convergence means for reducing the area of the individual cross sectional beams at said deflection means and for causing each of said cross sectional beams to individually cross over at said apertured plate.

10. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, beam shaping means for intercepting and simultaneously shaping said electron beam into a plurality of character shaped beams, each of said character shaped beams being distinct from the other of said plurality of character shaped beams, deflection means for deflecting said plurality of character shaped beams, means having an aperture therein, said deflection means being adapted to cause selection of one of said character shaped beams through said apertured means for impingement thereof onto said target, a first convergence means for causing said plurality of character shaped beams to cross over at the center of deflection of said deflection means, a second convergence means positioned adjacent said first convergence means for causing each of said character shaped beams to individually cross over at said apertured means and said first and second convergence means being capable of imparting said convergence effect on said shaped electron beams simultaneously.

11. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, beam shaping means for intercepting and simultaneously shaping said electron beam into a plurality of character shaped beams, each of said character shaped beams being distinct from the other of said plurality of character shaped beams, deflection means for deflecting said plurality of character shaped beams, a plate having an aperture therein, said deflection means being adapted to cause selection of one of said character shaped beams through said aperture for impingement thereof onto said target, a first convergence means and a third convergence means for causing said plurality of character shaped beams to cross over at the center of deflection of said deflection means, a second convergence means including a multiple lens member for causing each of said character shaped beams to individually cross over at said apertured plate, said respective convergence actions of said first and third convergence means and said second convergence meas occurring at substantially the same time to said shaped electron beams, said multiple lens having a separate lens element for each of said shaped beams, each of said lens elements being capable of causing its respective shaped beam to cross over on an axis separate and distinct from each of the other of said plurality of shaped beams.

12. A shaped beam tube comprising in combination within an evacuated envelope, a beam generating means positioned at one end of the envelope for generating and projecting an electron beam, and a target positioned at the other end of the envelope capable of responding to the electron beam, beam shaping means for intercepting and simultaneously shaping said electron beam into a plurality of character shaped beams, said beam shaping means having a matrix with character shaped apertures therein, said character shaped apertures having a predetermined spacing therebetween, each of said character shaped beams being distinct from the other of said plurality of character shaped beams, deflection means for deflecting said plurality of character shaped beams, a plate having an aperture therein, said deflection means being adapted to cause selection of one of said character shaped beams through said aperture for impingement thereof onto said target, a first convergence means for causing said plurality of character shaped beams to cross over at the center of deflection of said deflection means, a second convergence means including a multiple lens member for causing each of said character shaped beams to individually cross over at said apertured plate, said respective convergence actions of said first and second convergence means occurring at substantially the same time to said shaped electron beams, said multiple lens having a separate lens element for each of said shaped beams, each of said lens elements being capable of causing its respective shaped beam to cross over with a displacement therebetween having the same ratio as said spacing between said matrix apertures.

13. An electron optical system for use in shaped cathode ray tubes capable of simultaneously generating and projecting a plurality of shaped electron beams, comprising a first convergence means for causing a plurality of shaped electron beams to cross over at a predetermined point in said tube, a second convergence means operable substantially simultaneously with said first convergence means for causing ones of said electron beams to individually cross over at a point in said tube displaced from said predetermined point.

14. An electron optical system for use in shaped beam cathode ray tubes capable of simultaneously generating and projecting a plurality of shaped electron beams, comprising a first convergence means for causing a plurality of shaped electron beams to cross over at a predetermined point in said tube, a second convergence means operable substantially simultaneously with said first convergence means for causing ones of said electron beams to individually cross over at a point in said tube displaced from said predetermined point, said second convergence means having a separate lens element for each of said shaped beams, each of said lens elements being capable of causing its respective shaped beam to cross over on an axis separate and distinct from each of the other of said plurality of shaped beams.

References Cited in the file of this patent

UNITED STATES PATENTS

2,585,798	Law et al.	Feb. 12, 1952
2,660,612	Wood	Nov. 24, 1953
2,669,675	Lawrence	Feb. 16, 1954
2,752,520	Morrell	June 26, 1956
2,761,988	McNaney	Sept. 4, 1956