Aug. 12, 1958 R. McN. BOWIE 2,847,597

ELECTRON DISCHARGE DEVICE

Filed Nov. 25, 1955 3 Sheets-Sheet 1

FIG. 1

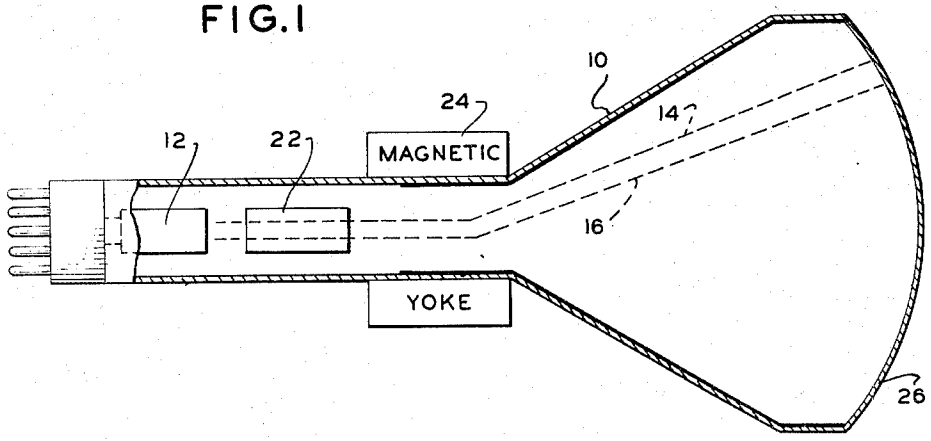
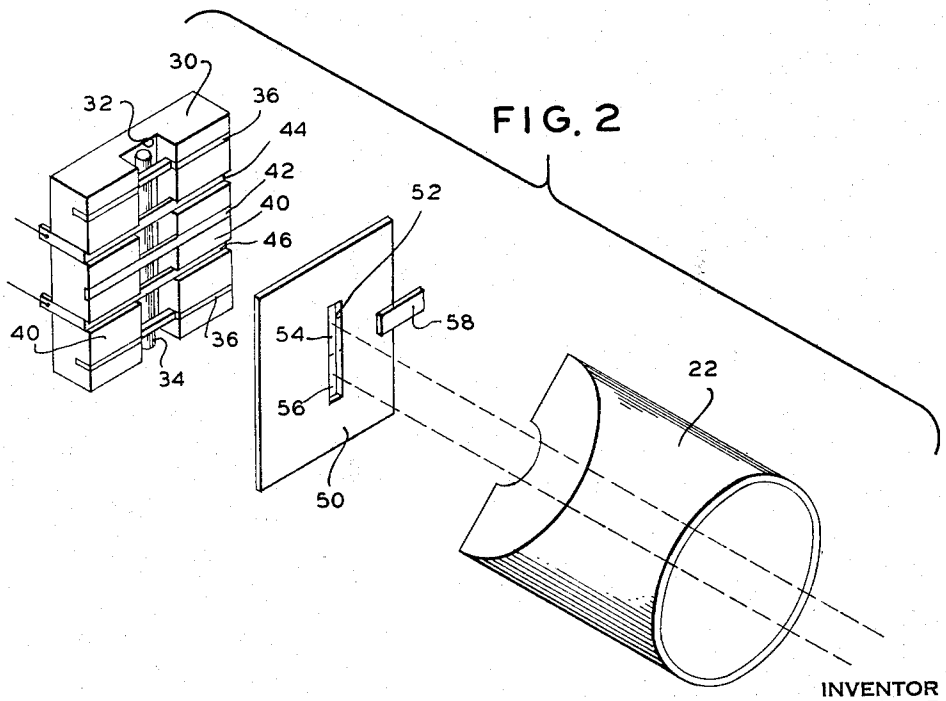


FIG. 2



INVENTOR
ROBERT M. BOWIE

BY Theodore Jay

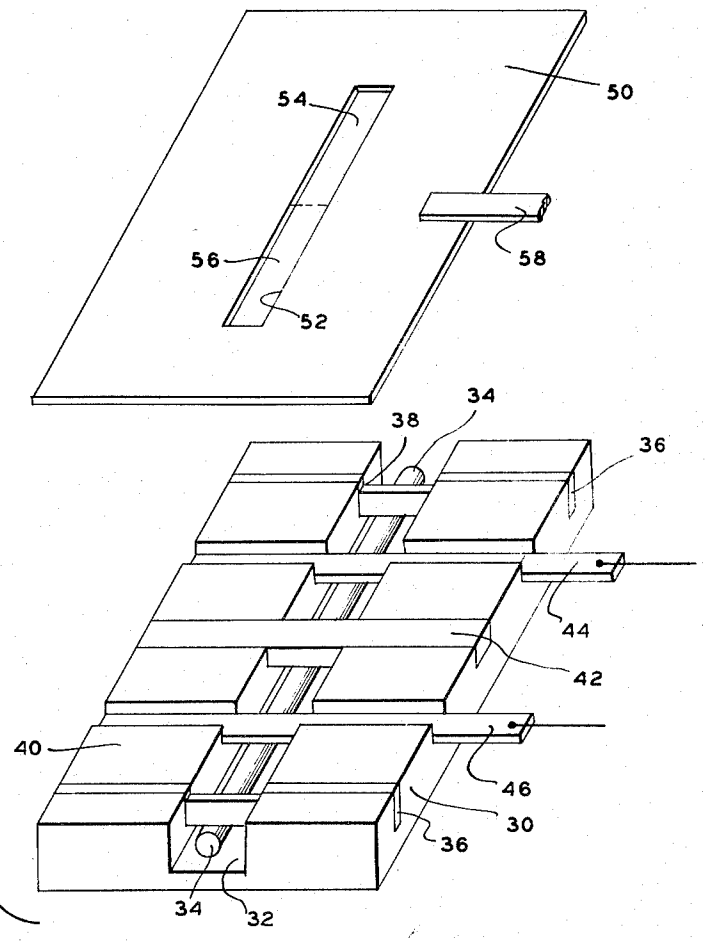
ATTORNEY

Aug. 12, 1958 R. McN. BOWIE 2,847,597

ELECTRON DISCHARGE DEVICE

Filed Nov. 25, 1955 3 Sheets-Sheet 2

FIG. 3



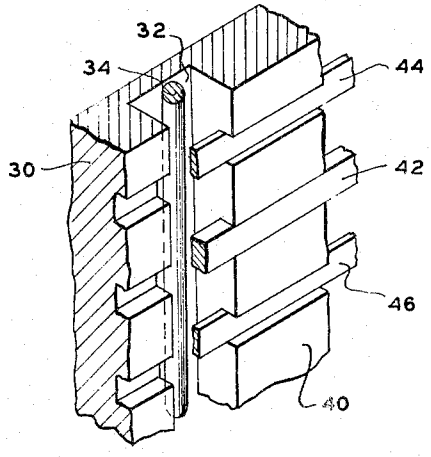


FIG. 4

INVENTOR
ROBERT M. BOWIE

BY Theodore Smyth

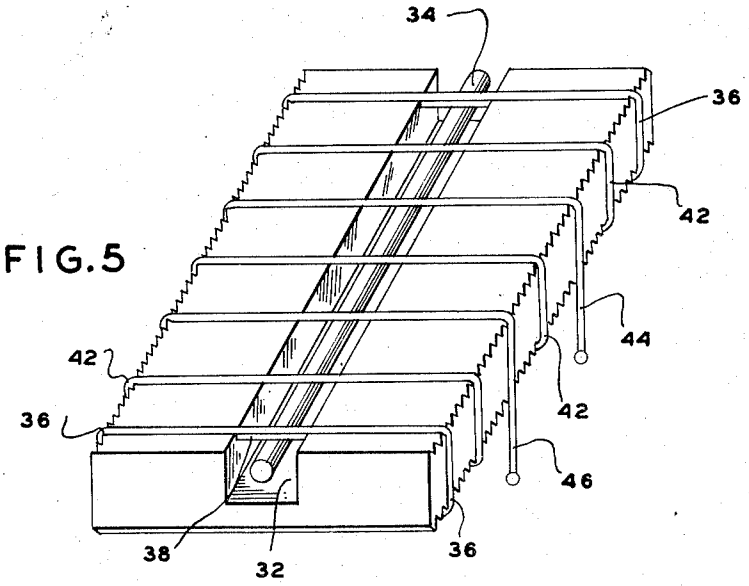
ATTORNEY

Aug. 12, 1958 R. McN. BOWIE 2,847,597

ELECTRON DISCHARGE DEVICE

Filed Nov. 25, 1955 3 Sheets-Sheet 3

FIG. 5



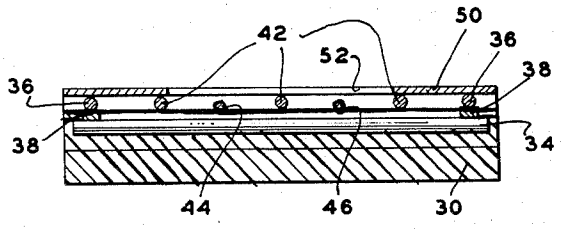


FIG. 6

INVENTOR
ROBERT M. BOWIE

BY Theodore Jay Jr

ATTORNEY

United States Patent Office 2,847,597 Patented Aug. 12, 1958

2,847,597

ELECTRON DISCHARGE DEVICE

Robert McNeil Bowie, Manhasset, N. Y., assignor to Sylvania Electric Products Inc., a corporation of Massachusetts

Application November 25, 1955, Serial No. 548,943

11 Claims. (Cl. 313—70)

My invention is directed toward improved cathode ray tubes and, more particularly, is directed toward improved electron gun structure for use therein.

Certain types of cathode ray tubes known to the art as multi-beam cathode ray tubes utilize a plurality of electron beams in a common envelope and find application in many diverse electronic fields. For example, oscilloscopes adapted to produce a plurality of test pattern displays simultaneously make use of such tubes, utilizing one electron beam for each display. Further, such tubes find increasing application in the color television art. For example, a tube utilizing two electron beams and adapted for color image display is disclosed in a copending application of Benjamin F. Tyson, Serial No. 516,668, filed June 20, 1955, and a tube of this general type utilizing four electron beams in a common envelope is disclosed in a copending application of Robert M. Bowie, Serial No. 477,161, filed August 24, 1953, now Patent No. 2,827,591, both of the above cases being assigned to the assignee of this application.

Certain multi-beam cathode ray tubes incorporate a separate electron gun structure for each beam. The incorporation of two or more electron guns in a single cathode ray tube of this type represents at best a complex and costly manufacturing procedure; each electron gun is a separate structure and must be separately mounted in the gun in such manner that all guns are fixedly spaced from each other. Extremely close tolerances are often required. Moreover, the difficulties of preventing electrical interaction between two or more guns require special shielding arrangements and the like.

I have succeeded in overcoming these difficulties and thereby greatly simplifying the construction of multi-beam cathode ray tubes by utilizing a single electron beam source and a beam splitting member separated from but in intimate association with the source in such manner that any desired number of electron beams can be derived from the single beam source.

Accordingly, it is an object of the present invention to improve multi-beam cathode ray tubes through the use of a single electron beam source and beam splitting means separated from and yet in intimate association with said source for deriving a plurality of electron beams therefrom.

Another object is to improve electron gun structures through the use of a single electron beam source and means separated from but in intimate association with said source to derive at least two beams therefrom and at the same time controlling the intensity of at least one of said beams.

Still another object is to provide a new and improved cathode ray tube in which a plurality of intensity controlled electron beams are derived from a single electron beam source by means of a beam splitting slotted member and intensity control electrodes spanning a portion of the slotted member.

These and other objects of my invention will either be explained or will become apparent hereinafter.

In my invention, an electron source such as a cathode is inserted in the neck of a cathode ray tube envelope. The source produces an electron stream which flows toward the tube screen. Interposed between the source and the screen of the cathode ray tube is a structure which derives a plurality of electron beams from said source. This structure is provided with at least one slot through which the electron stream flows and further includes beam splitting means associated with this slot. Said beam splitting means divide the slot into a plurality of sections and cause the stream to be distributed or apportioned within each section thereby producing a like plurality of electron substreams, each substream forming a single electron beam.

When the slot is rectangular in shape, all the electron beams so produced are substantially coplanar at the points of origin and at the points of termination at the screen. When the shape of the slot is varied from rectangular, non-coplanar beams can be produced. The beams in the region intermediate the points of origin and the points of screen termination may and generally do intermingle to follow substantially the same path through the focusing and deflecting means commonly employed in cathode ray tubes.

I further provide intensity control means associated with said slot to sepaartely control the intensity of at least one of said plurality of beams, as for example an intensity control electrode spanning the slot.

Illustrative embodiment of my invention will now be described in more detail with reference to the accompanying drawings wherein

Fig. 1 is a longitudinal section of a multi-beam cathode ray tube in accordance with my invention;

Fig. 2 is an exploded view of the electron gun structure used in Fig. 1;

Fig. 3 is an enlarged isometric exploded view of the cathode, slotted electrode and supporting structure used in Fig. 2;

Fig. 4 is a cross-sectional view of the slotted member and intensity control elements as used in Fig. 2;

Fig. 5 is an enlarged isometric view of an alternative structure to replace that shown in Fig. 3; and

Fig. 6 is a longitudinal sectional view of the structure shown in Fig. 5.

Referring now to Fig. 1 there is shown a multi-beam, in this example, a dual beam cathode ray tube **10** which can be either of the monochrome or color type. The tube includes a single electron gun structure identified generally at **12** which produces two electron beams **14** and **16**. The intensities of these beams are controlled by separate grids. The beams are vertically displaced from each other and are focussed, for example, by electrostatic focusing lens associated with electrode **22** and deflected, for example, through the action of magnetic yoke **24** to strike the image screen **26** in the manner indicated.

The gun structures as shown in Figs. 2, 3, and 4 include a ceramic rectangular block **30**. The block is provided with a rectangular channel **32** in which is mounted a conventional cathode **34** having an electron emissive plane or cylindrical surface which faces the tube screen. The cathode is of the indirectly heated type. The heater filaments and connections are conventional and are not shown here.

The block is also provided with grooves which contain cathode support and spacing members **36**. These members are bonded to the block and hold the cathode in place by supporting each end thereof. Sections **38** (Fig. 3) of said spacing members project downward into the channel thus positioning the electron emissive surface of the cathode somewhat below the top surfaces **40** of the ceramic block.

Additional grooves in the block contain a beam split-

ting member 42 and two beam intensity control elements 44 and 46.

Wire member 42 is flush with the top block surface 40. The intensity control elements 44, 46 are positioned below these surfaces.

The emissive surface of the cathode is displaced below the surface 40 of member 42 and elements 44 and 46 so as to provide a finite spacing therebetween.

Secured to the top block surfaces is a slotted metal electrode 50 provided with a rectangular slot 52 having its long dimension extending parallel to the axis of the cathode. The slot is so positioned with respect to the member 42 and control elements 44 and 46 that member 42 spans the width of the slot and divides the slot into two vertically displaced sections 54 and 56. These sections may or may not be equal depending upon the beam cross-section requirements. Each of the control elements also spans the width of the slot, one wire being positioned in each slot section.

The slotted electrode and member 42 are maintained in electrical contact with each other and form an equipotential surface; the control elements are insulatedly separated from the slotted electrode and member 42. A tab connection 58 is connected to the slotted member in conventional manner.

When the entire tube is assembled and rendered operative, the electron stream generated by the cathode passes through the slot. The electrons passing through the slot will tend to pass around member 42, thus forming two electron sub-streams or beams passing through slot sections 54 and 56, respectively.

When voltages are supplied to the control elements, each beam is intensity modulated in conventional manner; these beams are isolated from each other.

By omitting one or both control elements, each or both beams can be generated substantially free of intensity modulation. By increasing the number of beam splitting members, the slot can be divided into a larger number of subsections and the number of beams can be correspondingly increased. Additional control elements can be used to control the intensity of these additional beams. Further, it will be apparent that the shape of the ceramic block and cathode can be varied as necessary. For example, a cylindrical ceramic block having a central recess and a disc-like cathode mounted within the recess can be used. Moreover, the spacing between beams can be varied by varying the thickness of the beam splitting members.

The above structures can be adapted for automatic assembly in the manner shown in Figs. 5 and 6. The edges of the ceramic are threaded with a bifilar or double thread with very fine pitch. Grooves are provided for the cathode supports in the manner previously indicated and the cathode is placed within the block channel.

The center of the block is then wound with the two control elements and with three beam splitting members. (In this example, two additional beam splitting members are used.) These members are positioned about the edges of the slot to prevent fringe electric fields established about these edges from interacting with the electron beams. The beam splitting members have a relatively large cross-section and are to be in electrical contact with the slotted electrode. The control elements have a relatively small cross-section and are physically displaced from the beam splitting members and the slotted electrode.

A suitable frit is painted on the top surfaces of the block and on the elements and beam splitting members. The frit is then carefully removed from the top of the members. The slotted electrode, gold plated on its underside, is placed in contact with the beam splitting members.

The entire assembly is then fired in a non-oxidizing atmosphere to solder the beam splitting members to the slotted electrode and to frit down the wires. The members and the control elements can then be severed at the bottom of the block and suitably trimmed at the upper edge. The control elements are trimmed only at one end to provide suitable grid connections.

The diameter of the beam splitting members determines the spacing between the ceramic block and the slotted electrode. The control elements being of smaller diameter than the slotted electrode do not come in contact therewith. Hence, by varying the relative cross-sectional dimensions, the slotted electrode-ceramic block spacing can be varied as necessary.

While I have shown and pointed out my invention as applied above, it will be apparent to those skilled in the art that many modifications can be made within the scope and sphere of my invention as defined in the claims which follow.

What is claimed is:

1. In combination with first means for generating a single electron stream and second means for collecting said stream, a first electrically conductive member provided with a slot and positioned between said first and second means in such manner that said slot is interposed in the path of said stream in intimate association with said first means; at least one second electrically conductive member electrically connected to said first member and spanning said slot so as to divide said slot into two sections, said stream being apportioned between said sections to form corresponding electron beams as it passes through said slot; and a first beam intensity control electrode spanning one of said slot sections to control the intensity of the corresponding beam, said electrode being electrically insulated from said first and second members.

2. In combination with first means for generating a single electron stream and second means for collecting said stream, a first electrically conductive member provided with a slot and positioned between said first and second means in such manner that said slot is interposed in the path of said stream in intimate association with said first means; at least one second electrically conductive member electrically connected to said first member and spanning said slot so as to divide said slot into two sections, said stream being apportioned between said sections to form corresponding electron beams as it passes through said slot; and first and second beam intensity control electrodes electrically insulated from each other and from said first and second members, each of said electrodes spanning a corresponding slot section to control the intensity of said corresponding beam.

3. In combination with first means for generating a single electron stream and second means for collecting said stream, a first electrically conductive member provided with a slot and positioned between said first and second means in such manner that said slot is interposed in the path of said stream in intimate association with said first means; at least one second electrically conductive member electrically connected to said first member and spanning said slot so as to divide said slot into two sections, said stream being apportioned between said sections to form corresponding electron beams as it passes through said slot; and two additional beam configuration controlling second members spanning said slot in positions remote from the said one second member, all of said second members being parallel and being electrically interconnected through said slotted member to each other.

4. In combination, an electrically non-conductive member provided with a recess; a cathode structure positioned within said recess and secured to said member; an electrical conductive electrode secured to said member adjacent said recess, said electrode having a slot communicating with at least a portion of said structure; and at least one electrically conductive element electrically connected to said plate and spanning said slot.

5. The combination as set forth in claim 4 further including at least one additional element insulated from

said conductive element and said electrode and spanning said slot at a point spaced apart from said conductive element.

6. The combination as set forth in claim 5 wherein said element is interposed between said member and said electrode.

7. In combination, an electrically non-conductive block provided with a channel; a cathode structure positioned within said channel and secured to said block; an electrical conductive plate secured to said block adjacent said channel, said plate having a slot communicating with at least a portion of said structure; and at least one electrical conductive long narrow member electrically connected to said plate and spanning said slot.

8. The combination as set forth in claim 7 further including at least one control element spanning said slot in a position spaced apart from said member.

9. The combination as set forth in claim 8 wherein said element and said member are interposed between said block and said plate.

10. The combination as set forth in claim 9 further including two additional like members, said additional

members spanning said slot on opposite sides of said one member, said control element being positioned intermediate two of said members.

11. The combination as set forth in claim 10 wherein the cross section of said member exceeds that of said element whereby the spacing between said block and said plate is determined by the cross section of said members and said control element is electrically isolated from said member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,141,415	Schlesinger	Dec. 27, 1938
2,165,028	Blumlein	July 4, 1939
2,256,297	Smith et al.	Sept. 16, 1941
2,457,495	Rochester	Dec. 28, 1948
2,506,627	Barford	May 9, 1950
2,512,858	Hegbar	June 27, 1950
2,587,074	Sziklai	Feb. 26, 1952
2,732,516	Speedy	Jan. 24, 1956
2,758,234	Hensel	Aug. 7, 1956