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TARGET AREA SELECTION TYPE TUBE

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This invention relates to electron discharge devices of the target area selection type. More specifically this invention relates to an improved cathode and grid structure for electron discharge tube of the target area selection type.

Electron discharge tubes of the target area selection type are described and claimed in other applications by this applicant, Serial No. 665,031, filed April 26, 1946, now Patent No. 2,494,670 issued January 17, 1950, and Serial No. 118,758, filed September 30, 1949, both for "Electron Discharge Devices." These electron discharge devices are characterized by having a central source of electrons, a selecting grid which surrounds the electron source and target structure which envelops the above named structure. The storage portion of the target structure consists of a plurality of discrete storage areas usually regularly arranged in columns and rows. The selecting grid consists of a network of vertical conductors which are parallel, spaced and separately insulated and a network of horizontal conductors which are parallel, spaced and separately insulated. The selecting grid thus provides a plurality of rectangular openings or windows which are opposed to the plurality of discrete storage areas of the targets. By controlling the bias applied to any one of the four conductors defining a window, it is possible to determine whether or not electrons may pass from the electron source through that window to the opposed discrete target storage.

In operation, information is stored in each discrete storage area as a potential, either a cathode potential or a collector electrode potential. In quiescent intervals, which occur between periods when the target is being "written" into or "read," all the storage areas are bombarded by electrons. This serves as a locking mechanism to maintain all the storage areas at their potential and makes up losses due to leakage and other factors. The reading of information stored in the target is done while bombarding one storage area at a time and is evidenced by the presence or absence of a reading current in a reading target corresponding to the storage area being at collector or cathode potential. For complete information as to these processes reference should be made to the above indicated application.

Accordingly, it may be seen that it is advantageous to have as large an electron current flow to the storage target as possible, first, because it constitutes part of the "writing" mechanism and with a large electron current this process may be speeded up, second, because it provides the holding mechanism which serves to overcome the effects of detrimental leakage at the target, and third, it serves as part of the "reading" mechanism and the larger the electron current the larger the obtainable "reading" current and the more accurate the reading.

The amount of current which it is possible to obtain from a source of electrons depends both on the power applied and the efficiency with which that power is used to direct the electrons to a desired location. Since the power, which a tube of a given size can dissipate is limited, too large tubes not being practical and being slower in operation, the efficiency of the electron current delivery is an important factor in electron discharge tubes of the storage target area selecting type.

It is therefore an object of the present invention to provide an improved electron discharge device of the storage target area selecting type having a more efficient electron current delivery than heretofore.

It is a further object of the present invention to provide an improved electron discharge device of the storage target area selecting type having a greater electron current delivered to the storage target than heretofore.

It is still a further object of the present invention to provide a more, efficient cathode and accelerating grid structure for electron discharge tubes of the storage target area selecting type than heretofore.

These and other objects are achieved in accordance with my present invention by providing a storage target area selecting type of electron discharge device having a plurality of central, planar, spaced elongated cathodes each having a fluted Quadrilateral shaped cross sectional area and emanating four focussed electron beams. Each of the cathodes are disposed so that one diagonal is at right angles to the cathode plane. Accelerating grid structure surrounds each of the cathodes. It is so shaped and positioned with respect to the cathodes that the four electron beams from each cathode are deflected and focussed so that they strike the target storage areas at an angle normal thereto.

In one embodiment of the invention portions of the accelerating grid between the cathodes are square and portions on either side of each cathode are pentagonal. Vertical conductors of the selecting grid are alternately given U and V shapes in order to assist the accelerating grid in deflecting the electrons into a path normal to the discrete storage area of the target.

In a second embodiment of the invention the accelerating grid structure encloses each of the cathodes in a rectangular box with openings at the corners through which electrons pass to the targets. In a third embodiment of the invention the accelerating grid structure encloses each of the cathodes in a rectangular box and there are four openings provided in each box which are aligned with the discrete storage areas of the storage targets which enclose the tube structure.

The novel features of the invention, as well as the invention itself, both as to its organization and method of operation, will best be understood from the following description when read in connection with the accompanying drawings in which,

Figure 1 is a perspective view of the exterior of the electron discharge device, and

Figure 2 is a perspective view of an elongated cathode of the electron discharge device, and

Figure 3 is a cross-sectional view of the cathode, and

Figure 4 is a partial cross-sectional view of one embodiment of my present invention, and

Figure 5 is a partial cross-sectional view of another embodiment of my present invention, and

Figure 6 is a partial cross-sectional view of still another embodiment of my present invention.

Referring to Figure 1, there may be seen the elongated glass bulb **10** which encloses the tube structure and illustrates the general shape of the tube. Connections to the internal tube structure are made through stem leads **12** which are brought through the base of the bulb. The tube structure is supported by rods **14** which are braced against the top and bottom of the inner side of the glass bulb **10** in a manner well known to the art. The tube structure is contained within the rectangular shaped area **16** which conforms generally to the size of the target of the tube.

Figure 2 shows a perspective view of an elongated cathode **18**. The cathode length is determined by the length of the storage target to be supplied with electrons. A cross-sectional view of the cathode **18** is shown in Figure 3 taken along the line 3--3 in Figure 2. The cathode consists of a base metal tubing **20** such as nickel tubing having four equal fluted sides **22**, or the shape of a fluted, equilateral, quadrilateral coated, with electron emissive material **24**. Centrally disposed within the cathode is the heater wire **26**. This is surrounded by an insulator **28** such an conventional heater coating material on porcelain. The fluted cathode sides **22** enable a usage of the greatest part of the cathode area and provide four, focussed electron beams. The number of cathodes required to provide coverage of a storage target is thereby kept at a minimum.

Referring to Figure 4, a partial cross-sectional view of a tube structure of one embodiment of my invention is shown taken along the line 4--4 shown in Figure 1. It is to be noted that the tube structure is symmetrical having a central cath-ode plane wherein the cathodes **13** are positioned and the remaining tube structure is positioned on either side to sandwich the cathodes. Each cathode **18** is positioned so that one of its diagonals is normal to the cathode plane. An ac-celerating grid **30** encloses the cathodes **18**, and includes square conductors **32** and pentagonal conductors **34**. Alternate with and between the cathodes are the substantially square conductors **32** each of which is several times larger than a cathode and is positioned with one diagonal in the cathode plane. To facilitate outgasing the tube these conductors **32** are hollow. Spaced on either side of each cathode **18** is the pentagonal conductor **34** which is also a part of the accelerating grid **30**. The pentagonal conductor **34** has two equal sides at right angle to each other and making angles of 45 degrees with the plane of the cathodes and serve as a vertex for the conductor. This vertex points toward an associated cathode **18**. A plane, normal to the cathode plane and including a diagonal of a cathode included between two pentagonal conductors **34**, passes through the vertices and bisects the two pentagonal conductors. The two sides of the pentagonal conductors **34** which are adjacent to the two sides forming the vertex are also of equal length and sweep back from the cathode plane making a slight angle with a line normal to that plane. It is to be noted that the side of the pentagonal conductor opposed to the vertex is omitted. This is done because it serves no purpose at the rear of the conductor and by its omission and by making the conductor hollow the tube structure is considerably lightened and therefore easier to outgas.

Two square and two pentagonal conductors of the accelerating grid 3D surround each cathode and are coextensive with it. All the square and pentagonal conductors are connected together and serve as an accelerating electrode to which a potential is applied which is 15 to 60 volts positive with respect to the cathodes. This produces a positive gradient at the surface of the cathodes. Because of the curvature of the cathodes, the electrons are focussed into beams which for the most part passes through the channels between the squares and pentagons with only a small part being wasted on the accelerating grid itself.
On either side of the accelerating grid is a selecting grid **36**. Each selecting grid has a network of vertical selecting conductors which arc parallel to and coextensive with the cathodes and a network of horizontal selecting conductors at right angles to the cathodes. The vertical selecting conductors consist of U shaped conductors **38** which are positioned behind each pentagonal conductor **34** and V shaped conductors **40** which are spaced between the U shaped conductors **38**. The vertex of each V extends in the direction of an opposed square conductor and each V shaped conductor is bisected by a plane which passes through each opposed square conductor and includes a diagonal of that square conductor which is normal to the cathode plane. The V shaped conductors **40** are parallel to and co-extensive with the cathodes. The base of each U shaped conductor **38** is toward the pentagonal conductor **34** behind which it is positioned. The U shaped conductors **38** are also parallel to and coextensive with the cathodes. Both U and V shaped conductors are made hollow for lightness and their ends furtherest [sic] away from the cathodes terminate in a plane which is parallel to the cathode plane. It is to be noted that

the sides of the V shaped conductors near the ends are parallel to the sides of the U shaped conductors. When a potential, which is applied to the V shaped conductors, bears a definite relation to the potential applied to the accelerating grid **30** of approximately twice that potential, the electron beams from the cathode are deflected in the region between the pentagonal conductors and the V shaped conductors by an angle of 45 degrees and they then pass exactly in the center of the channels between the V and U shaped vertical conductors which are maintained at the same potential.

The network of horizontal selecting conductors consists of a plurality of rectangular conductors **42** which are all in a plane parallel to and spaced from each other and positioned at right angles to the network of vertical conductors. The length of the horizontal conductors **42** is determined by the size of the plane formed by the vertical network in the direction of the length of the horizontal conductors. The horizontal conductors are maintained at a potential somewhat higher than that applied to the vertical selecting bars but bearing no definite relation to it. When viewed from their outer side, the vertical and horizontal conductors of a selecting grid define a plurality of rectangular openings or windows the defining sides of which include two adjacent vertical conductors and two adjacent horizontal conductors. Electrons from the cathodes on the way to the target storage areas must pass through these windows. The theory of operation of a selecting grid, which permits the selection of any one window to be open to the passage of electrons while all others are closed, is described in detail in the above mentioned Patent No. 2,494,670. Briefly described, if two adjacent vertical conductors, which define two of the sides of a window which is desired to be left open to the passage of electrons, are biased at a potential which is positive with respect to the cathode (here approximately twice that of the accelerating grid), and if the two adjacent horizontal selecting conductors, defining the other two sides of the desired window, are also biased suitably positive (here this potential is slightly higher than the vertical conductor potential), then electrons may pass through the desired window. Should any one of the window defining selecting bars be made negative the electrons are deflected and will not pass through that window. Thus, by bringing out leads from each of the vertical **38**, **40** and horizontal conductors **42** and by application of the proper bias to those leads, complete control of the passage of electrons through any of the windows may be effectuated. Methods for effecting complete control of the electron stream utilizing a number of external leads which is less than the number of individual grid wires have been described and claimed in a copending application of J. A. Rajchman, Serial No. 702,775, filed October 11, 1946 and the application of George W. Brown, Serial No. 694,041, filed August 30, 1946 now Patent No. 2,519,172 issued August 15, 1950, and assigned to a common assignee.

Positioned on the outer side of each of the selecting grids **36** and parallel to the cathode plane are a first **43** and second **55** target assembly. These target assemblies are described and claimed in an application by Jan A. Rajchman for a "Target for Storage Tubes," Serial No. 122,657, filed October 15, 1949. The first target assembly consists of a collector electrode **44** which includes two flat metal plates perforated with round holes, the centers of which are aligned with the centers of the windows formed by the vertical and horizontal selecting bars. The first plate, which is nearest the horizontal selecting bars, is known as the collector mask **46** and has the smaller holes. The second plate, or collector spacer **48**, is in intimate contact with the collector mask and has the larger holes. Two parallel, spaced, insulating material sheets, **50**, such as mica, are positioned adjacent the outer side of the collector electrode **44**. These sheets are perforated and support between them, in the perforations, metallic storage eyelets **52**. The perforations are made so that the eyelets **52** are supported with their openings opposite the center of a selecting grid window. The eyelets **52** are generally cylindrical and have shoulder offset portions to be insulatingly retained thereby by the perforated mica sheets. Another metallic plate known as the writing plate **54** is positioned adjacent the outer insulating sheet **50** and has perforations which are aligned with the storage eyelets **52**. The writing plate is separated from the eyelets by the insulating material sheet and serves as a common capacity plate for all the eyelets.

A second target assembly **55** is spaced from the outer side of each of the first target assemblies. Each second target assembly **55** includes a reading plate **56** which is a metal plate having perforations aligned with the storage eyelets. Spaced from the reading plate is a Farady [sic] cage **58**. This is a rectangular metallic box in which two walls are parallel to the reading plate **56** and have perforations aligned with the reading plate perforations. A glass plate **60** coated with a fluorescent and secondary electron emitting material such as willemite is placed against the outer perforated wall of the Faraday cage **58**. In the central plane of the cage there are a number of reading wires **64** which are positioned so that they are between the perforations in the perforated walls and are thus shielded from any electrons which may be coming directly from the target as well as any electrostatic field leakage from the reading plate. These reading wires are connected together and the corresponding lead to the stem of the tube is shielded.

The operation of the above described electron discharge tube is substantially similar to the operation of the target area selecting type of tube described and claimed in my copending application, Serial No. 118,758, filed September 30, 1949. In the quiescent condition of the tube the vertical and horizontal selecting bars are all at the proper biasing potential to permit passage of electrons through each of the windows to strike each of the storage eyelets.

The act of reading or writing requires the selection of one eyelet or target element (two eyelets if the two halves of the tube are run in parallel). This selection is obtained by applying a negative pulse to one or more of the selecting bars defining all the windows except to the selecting bars defining the window which is left open.

For positive writing, after selection, a highly positive pulse is applied to the writing plate and is then allowed to slowly subside. The eyelet selected then remains at collector potential. For negative writing, after selection, a highly positive pulse is applied, but before it can subside the electron stream to the eyelet is cut off by applying a negative pulse to one of the four defining selecting conductors of the one open window. After the end of the highly positive pulse, all other pulses are ended and current is reestablished to all the eyelets.

The reading or interrogating of the tube constituting an embodiment of my invention is done by first closing all windows except the one opposite the storage eyelet whose condition is to be read. Some arbitrary short safety period thereafter, a positive reading pulse is applied to the reading plate which was previously negatively biased. If the selected storage eyelet is at collector potential electrons will pass through the storage eyelet into the Faraday cage where they strike the secondary emissive and fluorescent material through the hole in the Faraday cage wall causing fluorescence in the hole area and the release of secondary electrons which are then collected by the reading wires and cause a pulse of reading current in the reading wires. However, if the selected eyelet is at cathode potential no electron current passes through the storage eyelet and therefore no current will be detected in the reading wires. The target described and shown is merely by way of illustration and is not a part of this invention. Any of the other storage targets which are also shown and described in my copending application for an "Electron Storage Device with Grid Control Action," Serial No." 722,194, filed January 15, 1947, now Patent No. 2,513,743 issued July 4,1950, may be used instead. A requirement for the storage target used is that its discrete storage areas must be in rows and columns which are aligned with the windows of the selecting grid. The cathodes are usually positioned to be between alternate ones of said rows. The number of cathodes and their length as well as the number of conductors and their lengths for both the selecting grids and the accelerating grid are variable and are determined by the size of the storage target and the number of discrete storage elements contained therein.

It will be noticed that electron beams from adjacent cathodes cross each other in the regions between the pentagonal conductors. This effect produces no mutual interaction between the beams because of the extremely small size of the electrons and the negligible space charge effects. The reason for introducing such crossing is the fact that the beams are badly de-focused if deflected the appreciable angle of 45 degrees on too short a radius. If a reasonably large radius were used the tube would become unreasonably large and therefore the expedient of the crossings was resorted to.

Also illustrated in Figure 4 are some electron trajectories shown as lines with arrows for the condition when the windows are open. When any of the V conductors of a selecting grid are made negative the electron beams from the cathodes are deflected into the pentagonal conductors. If a V shaped conductor is made positive and the adjacent U shaped conductor is made negative, the electron beam is then deflected into the V shaped conductor. When both adjacent U and V shaped conductors are positive the electrons pass between them and if the eyelet is being read and is at collector potential the electrons continue to pass through the eyelet, through the Faraday cage and finally strike the willemite coating. The liberated secondary electrons, having a trajectory depicted as a dotted line, are drawn to the reading wires. This target operation is more fully described in the application for a "Target for Storage Tubes," identified above.

Support for the structure inside the glass envelope of the above described embodiment of my invention may be made in any manner well known to the art. External connection to the structures inside the envelope may be made through leads brought out through the base of the tube also in a manner well known to the art.

Referring now to Figure 5, another embodiment of my invention is shown in which the same cathode and target structure as are shown and described in Figure 4 are used. The view of the embodiment of my invention shown is a partial axial cross section also taken along the line 4--4 of Figure 1. In this embodiment of the invention the various structural elements of the tube are also symmetrically disposed on either side of the central cathode plane.

The accelerating grid **66** is box like and serves to enclose each of the cathodes in a rectangular box with openings at the corners through Which the electrons pass. Two metal plates **68** are spaced on either side of the cathodes **18** and parallel to the cathode plane. The metal plates **88** are longer than the elongated cathodes and sufficiently wider to permit total enclosure of the cathodes and retention by supporting structure (not shown) at the sides. The metal plates **68** are positioned on either side of the cathodes substantially just before the focused electron beams from adjacent cathodes cross each other. Rectangular openings are provided in the plates to permit passage therethrough of the focused beams. Completing the box like accelerating grid structure **66** are a plurality of rectangular conductors **70** each of which is centrally positioned between adjacent cathodes to be bisected by the cathode plane and is coextensive with the cathodes. The thickness and width dimensions of the rectangular conductors **70** are also determined so that they will not interfere with the focused electron beams of adjacent cathodes. The rectangular conductors **70** are provided with a series of fingers (not shown), by means of which they are welded to the flat plates to be supported thereby. The accelerating grid **66** is biased about 15 volts more positive than the cathodes. Spaced on either side of the flat plates of the accelerating grid is a selecting grid **72** including vertical **74** and horizontal **76** selecting conductors. The vertical selecting conductors **74** of this grid are rectangular conductors which are spaced, parallel to each other and to the cathode plane, are individually insulated, and are coextensive with the cathodes. The vertical selecting conductors **74** are disposed so that alternate ones are aligned with the rectangular conductors **70** of the accelerating grid **66** and the remaining ones of the vertical selecting conductors are aligned with those diagonals of the cathodes which are at right angles to the cathode plane. The horizontal selecting conductors **76** are rectangular conductors which are spaced, parallel, separately insulated and at right angles to the vertical conductors. As in the first embodiment of my invention the conductors of the selecting grid define a plurality of windows through which electrons from the cathodes pass from the cathodes to the target. Opening and closing of the windows may be obtained by the proper selection of the bias applied to the conductors defining the windows. In addition to the function of vertical selection the vertical selecting conductors **74** also assist in bending the electron streams from the various cathodes so that they will pass through the windows of the selecting grid to strike the target storage areas at right angles. For this purpose, alternate vertical selecting conductors are biased at a higher potential of approximately 70 volts positive with respect to the cathodes and the remaining ones are biased at a lower potential of approximately 50 volts positive with respect to the cathode. The horizontal selecting conductors are all maintained at a potential of approximately 100 volts positive with respect to the cathode.

The first and second target assemblies are the same as described above for Figure 4, and need not be redescribed. All apertures and discrete storage areas are aligned with the windows defined by the selecting grid conductors. The operation of this embodiment of my invention for writing and reading is the same as for the embodiment previously described. A few typical electron beam trajectories are represented in Figure 5 for the condition when the windows are open. It can be readily seen how the two focussed electron beams from two adjacent cathodes cross each other approximately outside the plane of the flat plates **68** of the accelerating grid **66** and are then bent by the vertical selecting conductors **74** to pass through each of the windows to be normal to the respective opposed discrete storage areas.

Figure 6 represents another embodiment of my invention using the same cathode and target structure as described previously herein. A first accelerating grid **78** structure consists of two flat plates **80** positioned on either side of the cathodes **18** to enclose them. Alternate with the cathodes and positioned between them are rectangular conductors, **82**, also part of the first accelerating grid **78**, which are bisected by the cathode plane. On either side of the flat plates **80** is a selecting grid **84** having vertical selecting conductors **86** and horizontal selecting conductors **88** which are rectangular and are disposed similarly with respect to each other and the cathodes and target as are the vertical and horizontal selecting conductors shown in Figure 5. However, a second accelerating grid **90**, consisting of a flat plate having a plurality of perforations aligned with the windows defined by the selecting grid conductors, is interposed between the horizontal **88** and vertical selecting **86** grid conductors. A first target assembly **43** and a second target assembly **55** are positioned on the outer side of each selecting grid and the collector holes and discrete storage areas are also aligned with the selecting grid windows.

The flat plates **80** which are a part of the first accelerating grid structure also have apertures which are aligned with the windows of the selecting grid **84**. The rectangular conductors **82** of the first accelerating grid have a thickness which is substantially equal to the distance between the apertures in the flat plates. These rectangular conductors serve to deflect the electron streams from the cathodes into the holes in the flat plates. An alternative description of the structure shown in Figure 6 is that the perforations in the two plates 80 of the first accelerating grid **78**, the perforations of the plate of the second accelerating grids 90 and the windows of the selecting grids **84** are all aligned with the discrete storage area's of the targets. These discrete storage areas are arranged in parallel rows and columns. Each of the cathodes **18** is positioned between alternate columns. Each of the first accelerating grid rectangular conductors **82** is alternate with a cathode 18 and together with the two flat plates **80** serves to enclose each cathode **18** in a rectangular box having openings at the corners through which electrons from the cathode may pass. Some typical tube bias values are, 17 volts above the cathodes for the rectangular conductors of the first accelerating grid, 74 volts above the cathodes for the flat plates, 220 volts above the cathodes for the vertical selecting conductors, 660 volts above the cathodes for the second accelerating grids, 660 volts positive above the cathode for the horizontal selecting grid, and 200 to 600 volts above the cathode for the collector potential.

Typical electron trajectories are shown in Figure 6 for the situation where the windows are open illustrating how the cathode beam is deflected by the rectangular conductors through the holes in the first accelerating grid plates and how any beam divergence is further corrected by the second accelerating grid. The operation of this embodiment of my invention for reading, writing, and discrete target area selection is the same as for the previously described embodiments of my invention and need not be redescribed here.

From the foregoing description, it will be readily apparent that I have provided an improved electronic discharge device of the storage target area selecting type wherein a row of fluted cathodes are used, each supplying four electron beams which are deflected so that they strike the discrete storage areas of the target normally, thus providing a more efficient selected electron current delivery. Although several embodiments of my invention have been shown and described, it should be apparent that many changes may be made in the particular embodiments herein disclosed, and that many other embodiments are possible, all within the spirit and scope of my invention. Therefore, I desire that the foregoing description be taken as illustrative and not as limiting.

What is claimed is:

1. An electron discharge tube of the type having a central planar source of electrons, a grid structure on either side of said planar source of electrons and a target structure on either side of said grid structure, said planar source of

electrons comprising a plurality of spaced, parallel coplanar elongated cathodes, each of said cathodes having the cross-sectional area of a polygon with fluted sides, a portion of said grid structure comprising an accelerating grid which surrounds each one of said cathodes and in which openings in said grid are provided between each of said cathodes to permit the flow of electrons therethrough to each of said targets from each of said cathodes.

2. An electron discharge tube of the type having a central planar source of electrons, a grid structure on either side of said planar source of electrons and a target structure on either side of said grid structure, said planar source of electrons comprising a plurality of spaced, parallel coplanar elongated cathodes, each of said cathodes having the cross-sectional area of a quadrilateral with equal fluted sides to provide four focussed electron beams, a portion of said grid structure comprising an accelerating grid which surrounds each one of said cathodes and in which openings in said grid are provided between each of said cathodes to permit the flow of electrons therethrough to each of said targets from each of said cathodes.

3. An electron discharge tube of the type having a central planar source of electrons, a planar storage target presented to either side of said; planar source of electrons and a grid structure disposed on either side of said source of electrons and between said source of electrons and said target, wherein said planar source of electrons comprises a plurality of spaced, parallel, coplanar, elongated cathodes, each of said cathodes having the cross sectional area of a quadrilateral with equal fluted sides to provide four focussing electron emitting surfaces and being positioned to have one diagonal of said quadrilateral perpendicular to both said planar storage targets.

4. An electron discharge tube of the type having a central planar source of electrons, a planar storage target presented to either side of said planar source of electrons and a grid structure disposed on either side of said source of

electrons and between said source of electrons and said target, wherein said planar source of electrons comprises a plurality of spaced, parallel, coplanar, elongated cathodes, each of said cathodes having the cross-sectional area of a quadrilateral with equal fluted sides to provide four focussing electron emitting surfaces and being positioned to have one diagonal of said quadrilateral perpendicular to both said planar storage targets, and said grid structure includes accelerating grid means to deflect the electrons emitted from said four electron emitting surfaces to strike normally said planar storage targets.

5. An electron discharge tube as recited in claim 4, wherein said accelerating grid means includes elongated conductors, each of which is disposed between adjacent ones of said plurality of spaced cathodes and are coextensive therewith, and other conductors disposed on either side of each of the plane of said cathodes and being parallel to and coextensive with said cathodes.

6. An electron discharge tube having a central planar source of electrons, an accelerating grid having portions interposed within and on either side of said planar source of electrons, a pair of selecting grids enclosing said accelerating grid .and source of electrons, and a pair of storage targets, each one being presented to the outer side of each of said selecting grids and having a plurality of discrete storage areas.

7. An electron discharge tube having a central planar source of electrons, a first accelerating grid having portions interposed within and on either side of said source of electrons, a pair of selecting grids which enclose said first accelerating grid and said source of electrons, each of said selecting grids including a network of vertical selecting conductors and a network of horizontal selecting conductors, a pair of second accelerating grids, each of said second accelerating grids being positioned between one of said vertical and horizontal selecting wire networks, and a pair of storage targets, each one of which is presented to the outer side of

each of said selecting grids, said targets being of the type having a plurality of discrete storage areas.

8. An electron discharge tube of the storage target area selecting type comprising a plurality of spaced, parallel, planar elongated cathodes, each having a fluted equilateral quadrilateral cross sectional area and being positioned to have , one of its diagonals perpendicular to the plane of said cathodes, accelerating grid means on either side of and between said plurality of cathodes to deflect electrons from each of said cathodes to a path normal to said cathode plane, a pair of selecting grids disposed on either side of and parallel to said cathode plane, and a pair of storage targets disposed on either side of said selecting grids and parallel to said cathode plane.

9. A cathode and accelerating grid structure for an electron discharge tube, said cathode structure comprising a plurality of spaced, parallel, planar, elongated cathodes, each having a fluted equilateral, quadrilateral cross sectional area, and being positioned to have one of its diagonals perpendicular to the plane of said cathodes, said accelerating grid structure comprising a plurality of square conductors, each of said conductors alternating and being coextensive with each of said cathodes and being between said cathodes, said conductors being positioned to have one diagonal perpendicular to the plane of said cathodes, and a plurality of pentagonal conductors coextensive with said cathodes, each of said pentagonal conductors having two sides of equal length and making an angle of 90 degrees with each other to form an apex, one of said pentagonal conductors, being in positioned on either side of each of said cathodes so that a plane containing the diagonal of said cathode normal to said cathode plane passes through and bisects each of said pentagonal conductors apices and said pentagonal conductors.

10. A cathode and accelerating grid structure for an electron discharge tube, said cathode structure comprising a plurality of spaced parallel planar elongated

cathodes each having a fluted equilateral, quadrilateral cross sectional in area providing four focussed electron beams and being positioned to have one of its diagonals perpendicular to the plane of said cathodes, said accelerating grid structure comprising a plurality of first rectangular conductors, each of said conductors alternating and being coextensive with and between said cathodes and being perpendicular to and bisected by said cathode plane, and a pair of conductive flat plates positioned parallel to said cathode plane, coextensive with and enclosing said cathodes, said plates having a plurality of rectangular openings which are opposed to and slightly wider than the dimension of each of said first conductors presented to said flat plates, said first conductors and said flat plates enclosing each of said cathodes in a rectangular box having openings at the corners through which the focussed electron beams emitted by each of said cathodes may pass.

11. An electron discharge tube having a central planar source of electrons, an accelerating grid having portions interposed between and on either side of said planar source of electrons, a pair of selecting grids which enclose said accelerating grid, and a pair of storage targets, each one being presented to the. outer side of each of said selecting grids, each of said targets being of the type having a plurality of discrete storage areas disposed in substantially parallel rows, said discrete storage areas of one of said targets being aligned with the discrete storage areas of the other of said targets, wherein said planar source of electrons includes a plurality of spaced, parallel, planar, elongated cathodes, each having a fluted equilateral, quadrilateral cross sectional area, each being positioned to have one of its diagonals perpendicular to the plane of said cathodes, and each being disposed between alternate ones of said parallel rows of discrete storage areas of said targets; wherein said accelerating grid comprises a plurality of square conductors each one of which alternates with each of said cathodes and is coextensive with and between said cathodes, said square conductors being positioned to have the cathode plane pass through one diagonal, and a plurality of pentagonal conductors coextensive with said

cathodes each of said pentagonal conductors having two sides of equal length and making an angle of 90 degrees with each other to form an apex, one of said pentagonal conductors being positioned on either side of each of said cathodes so that a plane containing the diagonal of said cathode normal to said cathode plane passes through and bisects each of said pentagonal conductors apices and pentagonal conductors; and wherein each of said selecting grids comprises a plurality of separately insulated spaced U shaped and V shaped vertical selecting conductors, each of said V shaped conductors being spaced from one of said square conductors and positioned with its apex toward said square conductor and positioned to be bisected by a plane which includes a diagonal of said square conductor and is at right angles to said cathode plane, each of said U shaped conductors being spaced from a pentagonal conductor and being positioned with the bottom of said U closest to and parallel to said cathode plane and to be bisected by said plane bisecting said pentagonal conductor, said U and V shaped conductors being parallel to and coextensive with said cathodes, and a plurality of separately insulated spaced parallel horizontal selecting conductors coextensive with said targets and together with said vertical selecting conductors defining a plurality of windows opposed to said plurality of discrete storage areas and through which electrons from said cathodes may pass to said storage areas.

12. An electron discharge tube having a central planar source of electrons, an accelerating grid having portions interposed within and on either side of said planar source of electrons, a pair of selecting grids which enclose said accelerating grid and source of electrons, and a pair of storage targets, each one being presented to the outer side of each of said selecting grids, each of said targets being of the type having a plurality of discrete storage areas disposed in substantially parallel columns, said discrete storage areas of one of said targets being aligned with the discrete storage areas of the other of said targets, wherein said planar source of electrons includes a plurality of spaced, parallel planar, elongated cathodes, each having a fluted equilateral, quadrilateral cross sectional area, each being positioned to have one of its diagonals perpendicular

to the plane of said cathodes, and each of said cathodes being disposed between alternate ones of said parallel columns of discrete storage areas of said targets; wherein said accelerating grid comprises a plurality of first rectangular conductors, each of said conductors alternating and being coextensive with each of said cathodes and being positioned to be perpendicular to and bisected by said cathode plane, and a pair of conductive flat plates positioned parallel to and spaced from said cathode plane, coextensive with and enclosing said cathodes, each of said plates having a plurality of rectangular openings which are opposed to and slightly wider than the dimension of each of said first conductors presented to said plates, said first conductors and said flat plates enclosing each of said cathodes in a rectangular box having openings at the corners through which electrons emitted by each of said cathodes may pass; and wherein each of said selecting grids comprises a plurality of separately insulated, spaced, parallel, rectangular, vertical conductors, said vertical conductors being spaced from said first conductors, coextensive with said cathodes and perpendicular to said cathode plane, each of said vertical conductors being positioned between said parallel columns of discrete storage areas, and a plurality of separately insulated, spaced, parallel, rectangular, horizontal selecting conductors coextensive with said target and together with said vertical selecting conductors defining a plurality of windows each of which is
opposed to one of said plurality of discrete storage areas and through which electrons from said cathodes may pass to said discrete storage areas.

13. An electron discharge tube having a central planar source of electrons, a first accelerating grid having portions interposed within and on either side of said planar source of electrons, a pair of selecting grids which enclose said first accelerating grid and said electron source, each of said selecting grids having a network of vertical selecting wires and a network of horizontal selecting wires, a pair of second accelerating grids, each of said pair of second grids being positioned between one of said vertical and said horizontal selecting wire networks and a pair of storage targets, each one being presented to the outer

side of each of said selecting grids, each of said targets being of the type having a plurality of discrete storage areas disposed in substantially parallel columns, said discrete storage areas of both said targets being in alignment with each other, wherein said planar source of electrons includes a plurality of spaced, parallel, planar, elongated cathodes, each having a fluted, equilateral, quadrilateral cross sectional area, each being positioned to have one of its diagonals perpendicular to the plane of said cathodes, and each of said cathodes being disposed between alternate ones of said parallel rows of discrete storage areas; wherein said first accelerating grid comprises a pair of conductive flat plates positioned parallel to said cathode plane, coextensive with and enclosing said cathodes, each of said plates having a plurality of apertures aligned with each of said discrete storage areas, and a plurality of first rectangular conductors, each of said conductors alternating with and being coextensive with each of said cathodes and being positioned between adjacent apertures in one of said flat plates and to be perpendicular to and bisected by said cathode plane; wherein said network of vertical selecting wires of each of said pair of selecting grids includes a plurality of separately insulated, spaced parallel, rectangular conductors, coextensive with said cathodes and each of said conductors being positioned between said aligned rows of discrete storage areas, and said network of horizontal selecting wires of each of said pair of selecting grids includes a plurality of separately, insulated spaced, parallel rectangular conductors, coextensive with said target and together with said vertical selecting wires defining a plurality of windows each of which is opposed to one of said plurality of discrete storage areas and through which electrons from said cathodes may pass to said discrete storage areas; and wherein each of said pair of second accelerating grids comprises a flat plate having a plurality of openings aligned with said plurality of discrete storage areas.

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