Feb. 9, 1954 H. C. JONAS ET AL 2,668,927

ELECTRON DISCHARGE DEVICE

Filed Nov. 20, 1951 2 Sheets-Sheet 1

FIG. 2

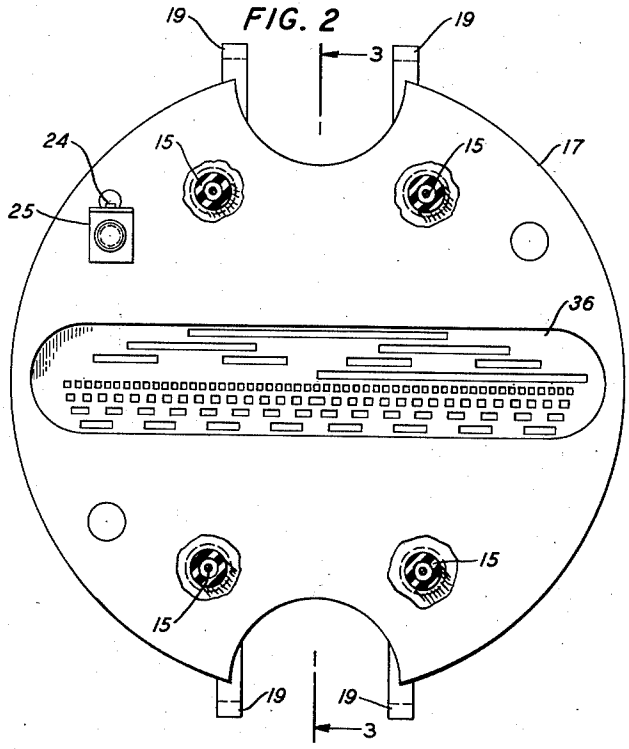


FIG. 3

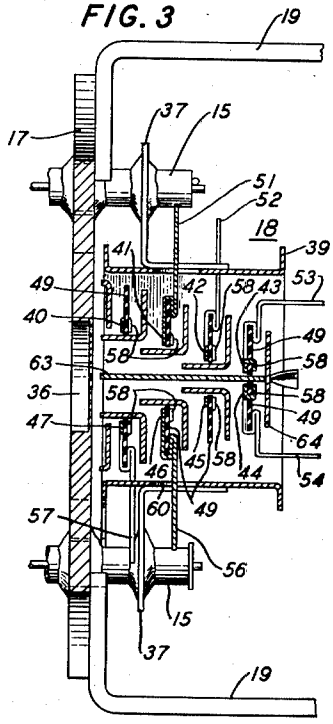


FIG. 4

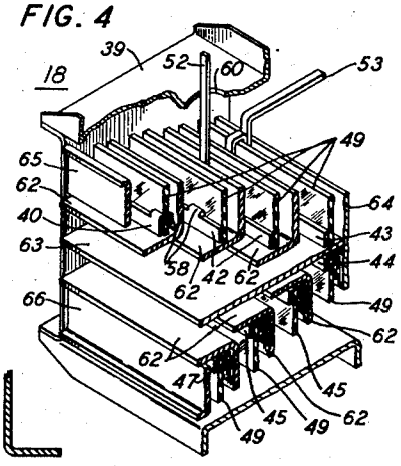
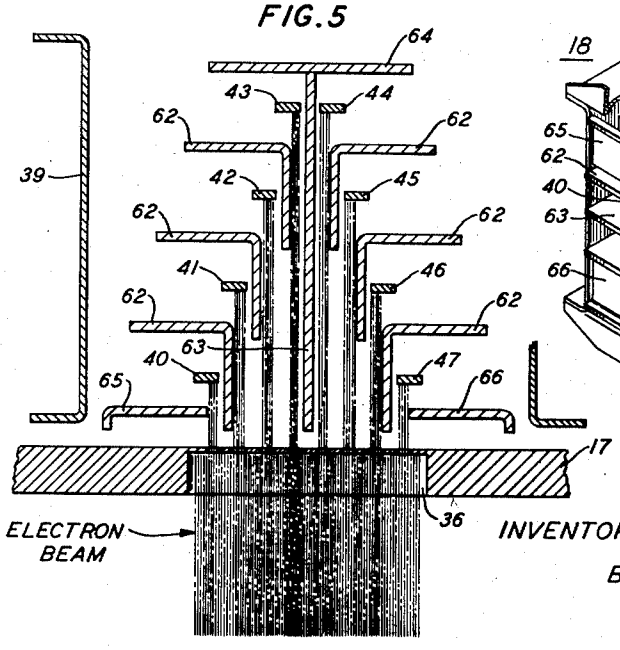


FIG. 5



INVENTORS H. C. JONAS
R. W. SEARS

BY

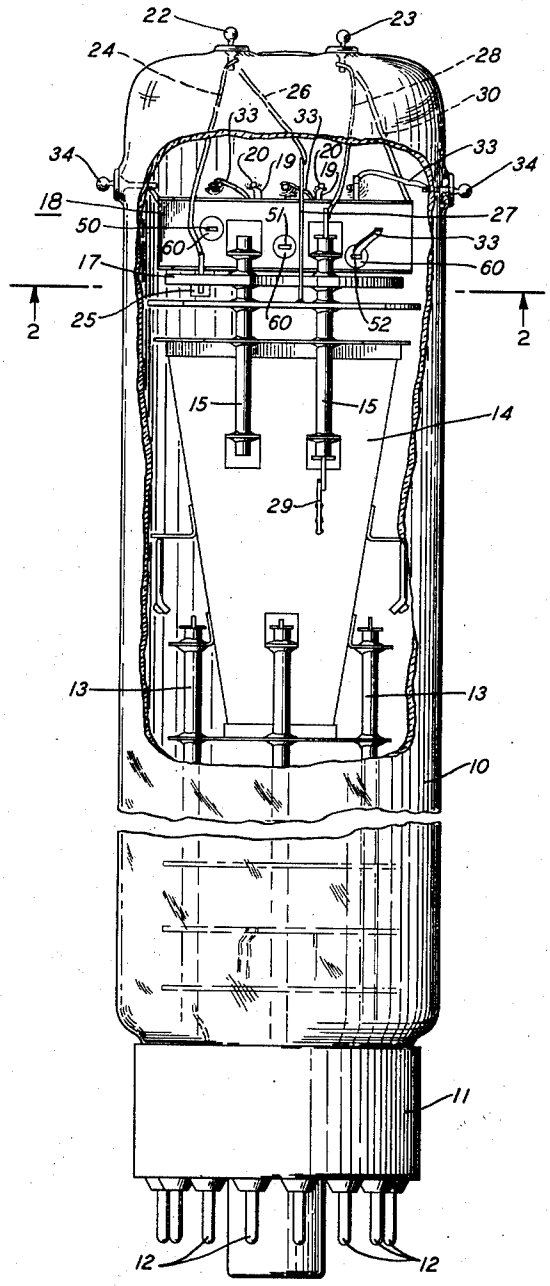
ATTORNEY

Feb. 9, 1954 H. C. JONAS ET AL 2,668,927

ELECTRON DISCHARGE DEVICE

Filed Nov. 20, 1951 2 Sheets-Sheet 2

FIG. 1



INVENTORS H. C. JONAS
R. W. SEARS

BY

ATTORNEY

Patented Feb. 9, 1954

2,668,927

UNITED STATES PATENT OFFICE

2,668,927

ELECTRON DISCHARGE DEVICE

Herbert C. Jonas, Summit, and Raymond W. Sears, West Orange, N. J., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application November 20, 1951, Serial No. 257,366

18 Claims. (Cl. 313—73)

1

This invention relates to electron discharge devices and more particularly to such devices of the electron beam type.

In the copending R. W. Sears application Serial No. 257,365 filed November 20, 1951, there is disclosed a specific embodiment of an electron discharge device of the type known as a "flash" coder, employable for coding operations in pulse code modulation systems. In a flash coder, a single wide electron beam is flashed onto a number of targets or output electrodes instantaneously rather than in succession, as occurs when a point electron beam is swept across the targets. When a point electron beam is employed, either a single target or a plurality of targets may be utilized, because of the time involved in the sweeping operation. However, when a flat wide electron beam is employed, a single target behind the apertured coding plate is insufficient.

Therefore a number of separate targets or output electrodes are positioned closely adjacent each other directly behind the apertured coding plate. Difficulty has been encountered, however, because of the large capacitances between these targets and the electronic and capacitive coupling between them. Additionally, a low output capacitance and the positioning of the targets so as to prevent secondary electrons from any target reaching adjacent targets are desirable.

It is one object of this invention to reduce electronic and capacitive coupling between the target elements in an electron discharge device.

It is another object of this invention to provide target or output electrodes for such a device having a low output capacitance.

A further object of this invention is to provide for the accurate positioning of a plurality of output elements closely adjacent each other so as not to be effected by defocussing of the electron beam or by secondary electron flow between targets.

A still further object of this invention is to provide an improved target assembly of output elements for an electron beam discharge device.

A still further object of this invention is to provide an improved electron beam discharge device of the flash coder type.

These and other objects of this invention are achieved in one specific embodiment of this invention wherein the target assembly comprises a plurality of long narrow output strips supported on insulators, such as mica strips, and mounted within a shield member in a substantially V-shaped array. Between each pair of targets an L-section shield is positioned, the L-section shields being supported by the outer shield

2

member. The insulating strips on which the collector plates are positioned are similarly supported by the outer shield member which has apertures therein allowing passage therethrough of terminals from the output strips to leads secured to individual button terminals in the envelope of the device. The electron beam is focussed on the apertured coding plate positioned immediately before the target assembly, but the positioning of targets or output elements at the apex of the V some distance behind the apertured plate does not interfere with proper coding because the focussed beam only spreads, on defocussing, along the length of the output elements.

The output strips are advantageously secured on the insulating strips in accordance with this invention by the terminals extending from the output strips to the leads which are attached to particular button terminals in the envelope of the device. The terminals of the output strips are advantageously formed integral with the strips and are bent over behind the back of the insulating strips and secured thereagainst to clamp the output strips in position. The output strips are further advantageously secured in position on the insulating strips by fingers advantageously integral with the output strips and extending through apertures in the insulating strips and bent thereagainst.

It is therefore one feature of this invention that a target assembly for an electron beam discharge device have a shield positioned between each target element and the elements adjacent thereto. More specifically, it is a feature of this invention that these shields be of L section and be positioned by a shield member enclosing the target assembly.

It is a further feature of this invention that the target or output elements be positioned in staggered planes and more specifically in a V-shaped array with the apex of the array farthest from the apertured coding plate of the electron discharge device.

It is a still further feature of this invention that the collector elements mounted in the V-shaped array in the target assembly comprise long narrow conducting strips positioned on insulating strips and specifically that these insulating strips be also positioned by the shield member enclosing the target assembly.

It is a further feature of this invention that the terminals extending from the output or target strips and attached to the leads extending to terminals in the envelope of the device be bent behind the insulating strips so as to clamp the out-

put strip onto the insulating strip. Further it is a feature of this invention that fingers extend from the output strips through apertures in the insulating strips and are bent behind the insulating strips to further clamp the output strips to the insulating strips. More specifically, in accordance with these features of this invention, the terminals and fingers extending from the output strips may be formed integral therewith.

A complete understanding of this invention and of the various features thereof may be gained from consideration of the following detailed description and the accompanying drawing, in which:

Fig. 1 is a side view of an electron beam discharge device in accordance with this invention, a portion of the envelope being broken away;

Fig. 2 is an enlarged plan view along the line 2—2 of Fig. 1 showing particularly one illustrative apertured coding plate;

Fig. 3 is a sectional view along the line 3—3 of Fig. 2 showing particularly one illustrative embodiment of a target assembly in accordance with this invention;

Fig. 4 is a perspective view of a section of the target assembly of Fig. 3; and

Fig. 5 is a simplified sectional view of a target assembly, in accordance with this invention, illustrating particularly the electron beam impinging on the collector elements of the target assembly.

Referring now to Fig. 1, there is shown an electron beam discharge device of the flash coder type illustrative of one specific embodiment of this invention. The device, which is further disclosed in the above-mentioned Sears application, comprises an envelope 10 having a base 11 attached thereto and terminals 12 for connection to electron gun means, signal deflection plates, and tilt plates, all not shown, for aligning the wide flat electron beam with the apertured coding plate, as set forth in the above-mentioned Sears application. These elements may advantageously be positioned by a first set of support rods 13 comprising an internal conducting rod and an insulating cement coating. The support rods 13 also support a flat hollow shield member or can 14 having trapezoidal sides. A second set of support rods 15 also comprising an internal conducting rod and an insulating cement coating are in turn secured to the shield can 14 and support, in succession, a rectangularly apertured shield plate 16, an apertured coding plate 17, and a target assembly 18 in accordance with this invention. The coding plate 17 and target assembly 18 are also secured to the envelope 10 by a plurality of anchor members 19, best seen in Fig. 3, which are secured to terminals 20 positioned in the envelope 10.

Four button terminals, of which only two numbered 22 and 23 are shown in Fig. 1, advantageously are sealed in the end of the envelope 10 and each has secured thereto a lead. These leads include a lead 24 attached to a connection member 25 secured to the coding plate 17, a lead 26 attached to a strut 27 extending from the rectangularly apertured shield plate 16, a lead 28 secured to the inner conducting member of one of the support rods 15 which in turn is connected by a lead 29 to the shield can 14, and a lead 30 secured to the outer shield member 39 of the target assembly 18, as described more fully below. Additionally, a plurality of leads 33 extend from the button terminals 34 positioned around the periphery of envelope 10 adjacent the target assembly to terminals attached to the individual output elements of the target assembly 18, as also explained further below.

The apertured coding plate 17, as shown in Fig. 2, may advantageously be of the reflected binary type disclosed in application Serial No. 785,697, filed November 13, 1947 of F. Gray but with certain of the rows of apertures interchanged to further aid in reducing the possibility of the effects of any misalignment. Further the four center codes have been omitted so that they may be used for signaling and other purposes, such as disclosed in C. B. H. Feldman application Serial No. 176,106, filed July 27, 1950. As best seen in Figs. 3 and 5 the apertures are all positioned in a depression 36 in the coding plate 17 and the target assembly 18 is supported by the support rods 15, as by support members 37 secured to the rods 15 by the insulating cement, directly adjacent to the coding plate 17 so that each row of apertures in the depression 36 in the coding plate 17 is directly aligned with one of the output electrodes of the target assembly 18.

Referring now to Figs. 3 and 4, one specific illustrative target assembly 18 in accordance with this invention comprises a hollow outer shield member 39 and a plurality of output electrodes 40, 41, 42, 43, 44, 45, 46 and 47 shown in this specific illustrative embodiment for an eight-digit code. Each collector electrode comprises a long narrow strip of a conducting material, as of nickel, mounted on a wider insulating strip 49, as of mica, which extends at its ends through the sides of the outer shield member 39 and is supported thereby. The output strips are secured to the insulating strips 49 by the terminals 50—57 which are integral with the output strips and are advantageously bent around the strips of insulating material and pinched as by fingers 58, as best seen in Fig. 4, also integral with the thin output electrode strips and extending through apertures in the insulating strips 49 and also pinched behind the insulating strips, thereby clamping the output electrode strips securely in place. Each of the terminals 50—57 extend through an aperture 60 in the outer shield member 39 and a lead 33 connects each of the terminals to one of the button terminals 34 in the periphery of the envelope 10.

As can readily be seen in the drawing, the output strips of the target assembly are mounted in a V-shaped array, the base of the V being provided by output strips 40 and 47 nearest the apertured coding plate 17 and the apex of the V by the output strips 43 and 44 most remote from the coding plate 17. As this specific illustrative embodiment comprises an even numbered digit code the apex of the V-shaped array is defined by two output strips whereas in an odd numbered digit code, such as a seven digit code, the apex of the V-shaped array would be defined by but a single output strip or electrode. Each of the output electrodes in each arm of the V is separated from the output electrodes adjacent thereto by an L-section shield member 62 which is supported in and electrically secured to ends of the outer shield member 39. Additionally, a central shield member 63 extends from the apex of the V-shaped array, thus separating the output electrodes 43 and 44, to the base of the array between the output electrodes 40 and 47 adjacent the coding plate 17. The central shield member 63 is also secured in and electrically attached to the ends of outer shield member 39

and a back shield member 64 is attached to the central shield member 63 and extends between the ends of the outer shield member 39 behind the apex of the V-shaped array, i. e., behind the output electrodes 43 and 44. Front shield members 65 and 66 are positioned adjacent to the output electrodes 40 and 41 respectively and between them and the apertured coding plate 17; the front shield members 65 and 66 also extend between and are supported by the ends of outer shield member 39. It is therefore apparent that each output electrode in the V-shaped array is substantially surrounded by shielding members and thus is separated from the neighboring output electrodes by shielding members.

Fig. 5 is a simplified representation of the target assembly showing the electron beam impinging on the output electrodes, a signal being assumed such that the electron beam has been deflected to traverse an aperture or slit in each of the rows in the apertured coding plate and thus impinges on all the output electrodes at the same time. Each of the output electrodes of course extends in alignment with the digit columns of the coding plate so that each is individually responsive to the electron beam current passing through its associated column of apertures in the coding plate. By arranging the output electrodes in a V-shaped array, so that the output electrodes are positioned in staggered planes, a maximum spacing between adjacent electrodes is attained as well as a maximum spacing between each output electrode and the shielding members. As can be seen the front shielding members 65 and 66 and the L-section shielding members 62 are so aligned as not to interfere with the passage of the electron beam from a given column of apertures in the coding plate to a specific output electrode. Thus the L-section electrodes are advantageously of a width equal to or less than the spacing between adjacent columns of apertures in the coding plate 17.

While the shielding members have been disclosed as separate from the outer shield member 39, it is to be understood that they are supported thereby and electrically connected thereto, so that the various shielding members can be considered as a single shield which enables capacitive and electronic coupling between output electrodes to be maintained at a minimum. Ideally, each of the L-section shield members 62 would extend to the side walls of the outer shield member 39, but the shorter members, each identical with each other, have been found to provide substantially complete shielding and to simplify greatly the fabrication of the target assembly.

The shield members, which are connected to one of the end button terminals by the lead 30, may advantageously be operated at a negative potential relative to the output electrodes so that any secondary electrons produced at the surfaces of the electrodes are suppressed. Alternatively, the output electrodes may be fabricated of a suitable material to produce a high and uniform secondary emission, in which case the shield members are at a positive potential to collect secondary electrons which originate at the output electrodes and thus provide increased output currents of reversed polarity.

In one specific illustrative embodiment of this invention, the shield members were of nickel and were carbonized to inhibit secondary emission. The output electrodes were strips of nickel .030 inch wide and 1.820 inches long and were formed by a punching operation, the fingers 58 and output electrode terminals being integral with the output electrode and formed at the same time. The insulating members 49 are of mica .140 inch wide and 1.882 inches long. The output electrodes were positioned in the V-shaped array .098 inch from the neighboring output electrode in that arm of the array. The over-all dimensions of the outer shield member 39 of the target assembly were 2.026 inches long, 0.829 inch wide, and $1\frac{7}{32}$ inch deep.

It is to be understood that the above-described arrangements are illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A target assembly for an electron discharge device comprising an outer shield member, a plurality of targets in said shield member and arranged therein in staggered parallel planes forming a substantially overlapping array, shield means positioned between each of said targets and the adjacent targets, said shield means together with said outer shield member substantially encompassing each of said targets, and lead means associated with each of said targets and extending out of said outer shield member.

2. A target assembly for an electron discharge device comprising an outer shield member, a plurality of conducting targets extending in said shield member and arranged therein in staggered planes, shield means positioned between each of said targets and the adjacent targets, said shield means including L-sectioned shielding members having one arm extending towards one side of said outer shielding member and the other arm extending in the direction of electron flow in said device, said shield means together with said shield member substantially encompassing each of said targets while allowing ingress of electrons to impinge on each of said targets, and lead means associated with each of said targets and extending out of said outer shield member.

3. A target assembly for an electron discharge device comprising an outer shield member, a plurality of conducting targets extending in said shield member and arranged therein in staggered planes, insulating means independently supporting each of said targets from the ends of said member, shield means positioned between each of said targets and the adjacent targets, said shield means including L-sectioned shielding members having one arm extending towards one side of said outer shield member and the other arm extending in the direction of electron flow in said device, said shield means together with said shield member substantially encompassing each of said targets while allowing ingress of electrons to impinge on each of said targets, and lead means associated with each of said targets and extending out of said outer shield member, said lead means comprising terminals integral with said conducting targets and bent over behind said insulating means to clamp said conducting targets to said insulating means.

4. A target assembly for an electron discharge device comprising an outer shield member, a plurality of targets extending in said shield member and arranged therein in a substantially V-shaped array, shield means positioned between adjacent targets in said array, said shield means together

with said shield member substantially encompassing each of said targets while allowing ingress of portions of an electron beam to each of said targets, said shield means being of width substantially equal to the spacing between the portions of the electron beam directed toward each of said targets, and lead means associated with each of said targets and extending out of said outer shield member.

5. A target assembly for an electron discharge device comprising an outer hollow shield member having side and end portions, a plurality of conducting strips extending the length of said member and arranged therein substantially in a V-shaped array, insulating means independently supporting each strip from the ends of said member, shield means between each of said strips in said array, said shield means together with said hollow shield member substantially encompassing each of said strips, and lead means associated with each of said strips and extending out of said outer shield member.

6. A target assembly for an electron discharge device in accordance with claim 5 wherein said lead means comprises terminals integral with said conducting strips and bent over behind said insulating means to clamp said conducting strips to said insulating means.

7. A target assembly for an electron discharge device in accordance with claim 6 wherein said insulating means have apertures therethrough and comprising fingers integral with said conducting strips extending through said apertures and bent over behind said insulating means to clamp said conducting strips to said insulating means.

8. A target assembly for an electron discharge device comprising a hollow shield member having side and end portions, a plurality of narrow conducting strips extending the length of said member and arranged therein substantially in a V-shaped array, an insulating member supporting each of said strips from the ends of said member, shield means between each of said strips in said array, said shield means comprising substantially L-section members having one arm extending towards the base of said V-shaped array and the other arm extending towards one side of said hollow shield member, and lead means associated with each of said strips and extending out of said hollow shield member.

9. A target assembly for an electron discharge device comprising a hollow outer shield member having side and end portions, a plurality of narrow conducting strips extending in said hollow member and arranged therein substantially in a V-shaped array, an insulating strip supporting each of said conducting strips from the ends of said shield member, lead means associated with each of said conducting strips and extending out of said hollow shield member, said lead means comprising terminals integral with said conducting strips and bent over behind said insulating strips to clamp said conducting strips to said insulating strips, and shield means between each of said conducting strips in said array, said shield means comprising a plurality of substantially L-section members which together with said hollow outer shield member substantially encompass each of said strips.

10. A target assembly for an electron discharge device in accordance with claim 9 wherein said insulating strips have apertures therethrough and comprising fingers integral with said conducting strips extending through said apertures and bent behind said insulating strips to clamp said conducting strips to said insulating strips.

11. A target assembly for an electron discharge device comprising an outer shield member having side and end portions, a plurality of narrow conducting strips extending the length of said member and arranged therein substantially in a V-shaped array, said plurality being an even number and the apex of said array comprising two of said strips, an insulating strip supporting each of said conducting strips from the ends of said shield member, and shield means between each of said conducting strips, said shield means comprising a central shield plate secured to the ends of said hollow shield member and extending from between said two conducting strips at the apex of said array to the base of said array, a back shield plate secured to said central plate and to the ends of said array, a plurality of L-section shield members secured to the ends of said outer shield member and positioned between adjacent conducting strips in each arm of said array, one arm of said L extending towards the base of said array and the other arm of said L extending towards one side of said shielding member, and front shield members positioned adjacent the conducting strips in the base of said array and secured to the ends of said outer shield member, said shield means and said outer shield member substantially encompassing each of said conducting strips while allowing ingress of an electron beam to impinge on said conducting strips, and lead means associated with each of said strips and extending out of said hollow shield member.

12. A target assembly for an electron discharge device in accordance with claim 11 wherein said lead means comprises terminals integral with said conducting strips and bent over behind said insulating strips to clamp said conducting strip to said insulating strips.

13. An electron discharge device comprising an apertured coding plate having a plurality of rows of apertures therein, means removed from said plate and to one side thereof for projecting and focussing an electron beam against said plate, and a target assembly adjacent said plate to the other side thereof, said assembly comprising a hollow shield member having end and side portions, a plurality of conducting strips extending in said shield member and arranged therein in a substantially V-shaped array, one of said strips being aligned directly behind each of said rows of apertures in said coding plate, insulating members extending between the ends of said shield member, one of said insulating members supporting each of said conducting strips, and shield means between adjacent conducting strips in said array, said shield means and said outer shield member substantially encompassing each of said conducting strips but defining discrete paths for the electrons emerging through said apertured coding plate to impinge on said conducting strips.

14. An electron discharge device comprising an envelope, an apertured coding plate having a plurality of rows of apertures therein positioned within said envelope, means removed from said plate and to one side thereof within said envelope for projecting and focussing an electron beam against said plate, a target assembly adjacent said plate to the other side thereof, a plurality of terminals extending through said envelope adjacent said target assembly, said target assembly comprising a hollow shield member having end and side portions, a plurality of narrow conducting strips extending the length of

said member and arranged therein in a substantially V-shaped array, one of said strips being aligned directly behind each of said rows of apertures in said coding plate, insulating strips extending between the ends of said shield member and supported thereby, shield means between adjacent conducting strips in said array, said shield means and said outer shield member substantially encompassing each of said conducting strips but defining discrete paths for said electrons emerging through said coding plate to impinge on said conducting strips, and terminals integral with said conducting strips and bent over behind said insulating strips to clamp said conducting strips to said insulating strips, and lead means connecting each of said conducting strip terminals to one of said terminals extending through said envelope.

15. An electron discharge device in accordance with claim 14 wherein said insulating strips have apertures therein and comprising fingers integral with said conducting strips extending through said apertures and bent over behind said insulating means to clamp said conducting strips to said insulating means.

16. An electron discharge device in accordance with claim 14 wherein said shield means includes L-section shielding members secured to the ends of said outer shield member and positioned between adjacent conducting strips in each arm of said array.

17. An electron discharge device in accordance with claim 16 wherein one arm of the L of said L-section shielding members extends towards said apertured coding plate and the other arm of said L extends towards one side of said shielding member, said arm extending towards said apertured coding plate being of a width at least no greater than the distance between adjacent rows of apertures in said plate.

18. An electron discharge device comprising an envelope, an apertured coding plate having a plurality of rows of apertures therein positioned within said envelope, means removed from said plate and to one side thereof within said envelope for projecting and focussing a flat wide electron beam on said plate, a target assembly adjacent said plate to the other side thereof, a plurality of terminals extending through said envelope adjacent said target assembly, said target

assembly comprising a hollow outer shield member having end and side portions, a plurality of narrow conducting strips extending the length of said member and arranged therein in a substantially V-shaped array, said plurality being an even number and the apex of said array comprising two of said strips, one of said strips being aligned directly behind each of said rows of apertures in said coding plate, insulating strips supporting each of said conducting strips from the ends of said shield member, shield means between each of said conducting strips, said shield means comprising a central shield plate secured to the ends of said hollow shield member and extending from between said two conducting strips at the apex of said array to the base of said array, a back shield plate secured to said central plate and to the ends of said array, a plurality of L-section shield members secured to the ends of said outer shield member and positioned between adjacent conducting strips in each arm of said array, one arm of said L extending towards said apertured coding plate and the other arm of said L extending towards one side of said outer shield mmeber, and front shield members positioned adjacent said conducting strips at the base of said array between said base conducting strips and said coding plate, said shield means and said outer shield member encompassing each of said conducting strips but defining discrete paths for said electrons emerging through said apertured coding plate to impinge on said conducting strips, and terminals integral with said conducting strips and bent over behind said insulating strips to clamp said conducting strips to said insulating strips, and lead means connecting each of said conducting strip terminals to one of said terminals extending through said envelope.

HERBERT C. JONAS.
RAYMOND W. SEARS.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,190,069	Hollmann	Feb. 13, 1940
2,202,376	Hansell	May 28, 1940
2,361,766	Hadekel	Oct. 31, 1944
2,458,652	Sears	Jan. 11, 1949
2,472,779	Selgin	June 7, 1949
2,532,747	Van Gelder et al.	Dec. 5, 1950