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Landrum

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[54] MULTI-BEAM ELECTRON BEAM SCANNER UTILIZING A MODULATION PLATE FOR MODULATING EACH OF THE BEAMS INDEPENDENTLY

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[52] **U.S. Cl.** .....**315/13 R,** 315/12

[51] **Int. Cl.** **H01j 29/50**

[58] **Field of Search** 315/12, 13

[56] **References Cited**

UNITED STATES PATENTS

3,408,532	10/1968	Hultberg et al.	315/12
3,382,392	5/1968	Corpew	315/13
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FOREIGN PATENTS OR APPLICATIONS

1,023,887	3/1966	Great Britain	315/13

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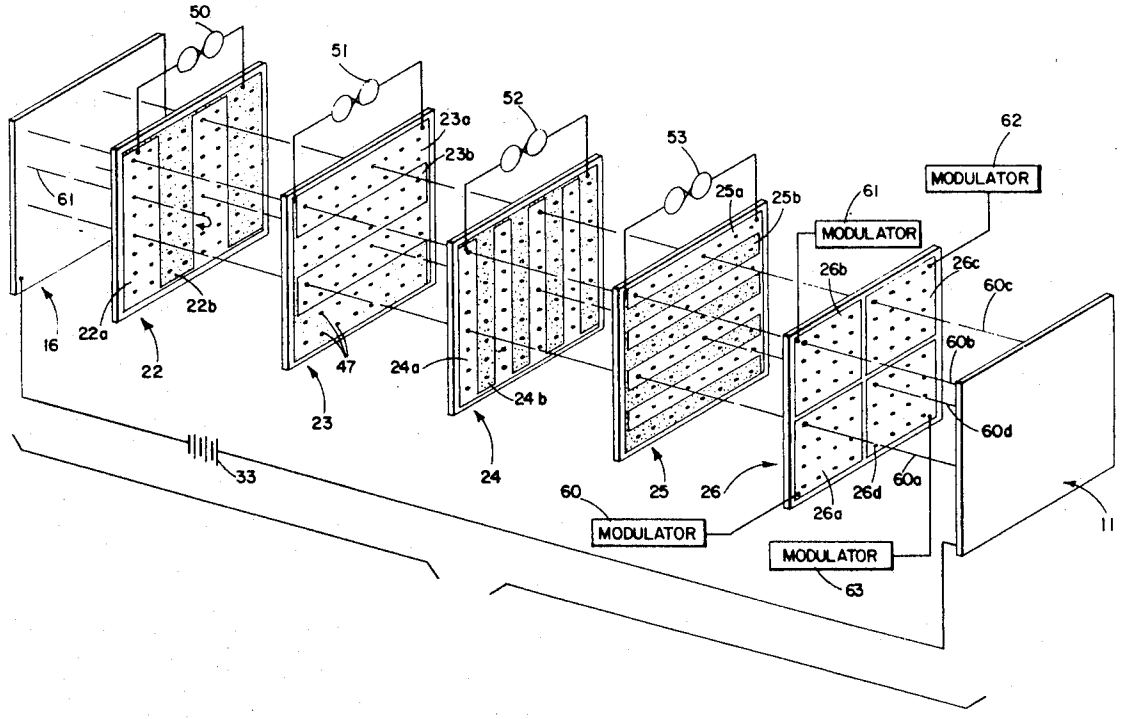
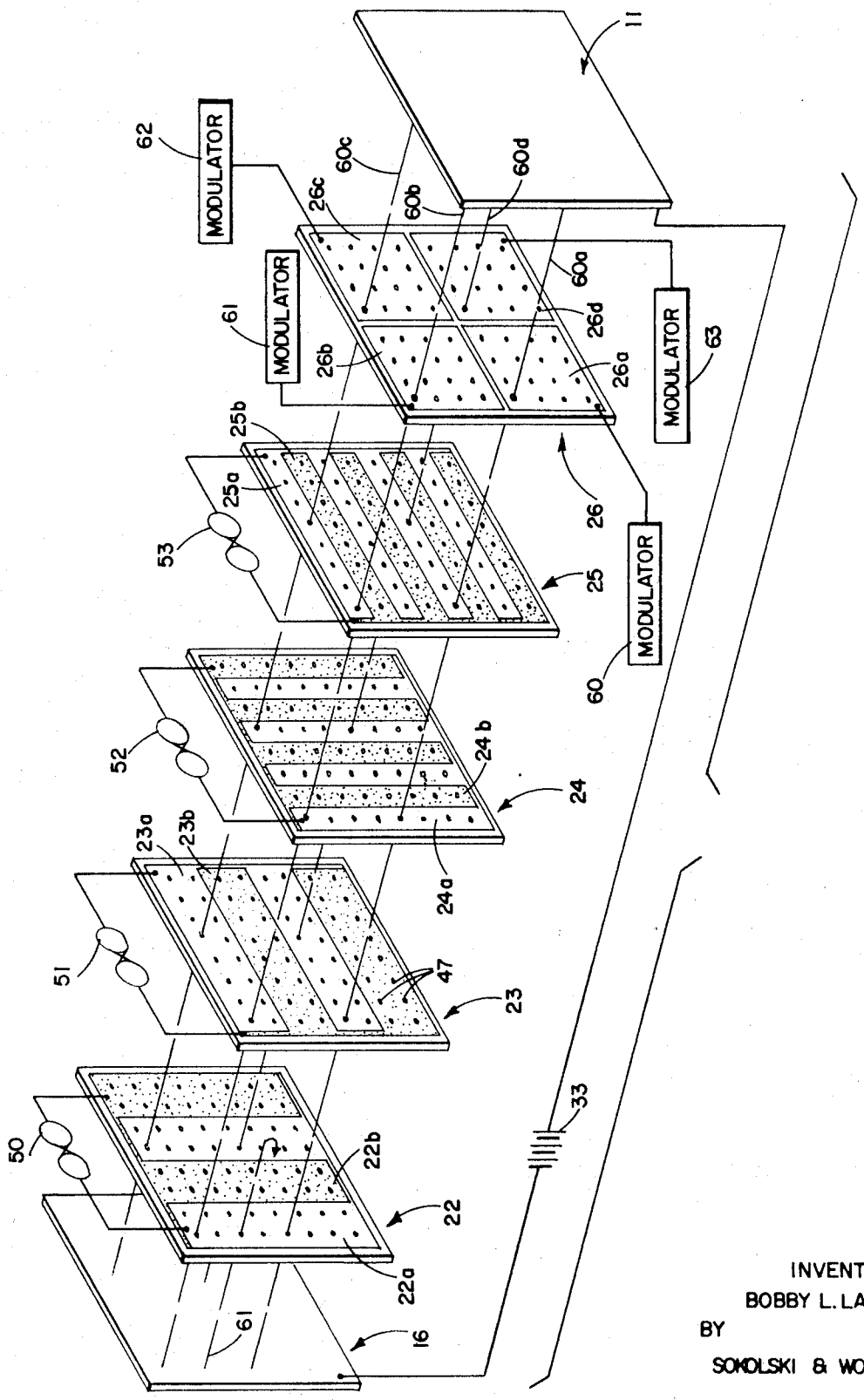
[57] **ABSTRACT**

A plurality of flat coded dynode members are sandwiched between an electron emitting cathode in the form of flat plate and a flat target plate. Each dynode member has a plurality of apertures formed therein which are aligned with corresponding apertures on all of the other dynodes, each such set of aligned apertures forming an electron beam channel. The dynodes also each have a pair of separate conductive finger patterns, the finest of such finger patterns defining an elemental scanning area of the target plate. The finger patterns and number of dynodes utilized are chosen so as to provide a predetermined number of simultaneous scanning beams. A modulation grid having apertures therein corresponding to the apertures on the dynode and having separate portions covering the areas encompassed by each of the scanning beams is placed between the cathode and target to control the energization of the beams.

4 Claims, 1 Drawing Figure





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MULTI-BEAM ELECTRON BEAM SCANNER UTILIZING A MODULATION PLATE FOR MODULATING EACH OF THE BEAMS INDEPENDENTLY

This invention relates to an electron beam scanner and more particularly to such a scanner utilizing flat dynode control elements and a modulation dynode element, which is capable of multi-beam operation.

In U.S. Pat. No. 3,408,532 to D. E. Hultberg et al, assigned to Northrop Corporation, the assignee of the instant application an electron beam scanner is described which utilizes a plurality of finger pattern coded dynode members sandwiched between an electron emitting cathode and a target plate wherein each of the dynodes has a pair of separate conductive portions arranged in a pre-determined finger pattern. The dynode apertures are aligned with each other to define electron beam channels running between the cathode and the target each of such channels defining a scanning element of the target. The dynode fingers are excited in response to binary control signals to activate one of the channels at a time so as to address the beam to the target in a pre-desired manner.

There are certain advantages to providing a plurality of beams which simultaneously scan different portions of the target in an electron beam scanner of the type described in the aforementioned patent. First, this type of multiple beam operation can provide a plurality of separate displays simultaneously. In this manner, the information handling capability of the scanner can be augmented. Further, the plural beams can be utilized to simultaneously provide different portions of the same display. Thus, for example in the case of a television picture, various sections of this picture can be simultaneously registered on the target, these different portions being synthesized by the eye to form the total display. This type of simultaneous beam scanning has an advantage in that each simultaneously scanning beam can scan at a lower rate for any given total scanning period, thus enabling greater dwell time for the beam at each target resolution element thus affording increased brightness of the display.

The device of this invention involves a modification to the device of the aforementioned patent to enable beam operation wherein each of the beams may be excited in response to separate modulation control signals. It is to be noted that the device of the invention can be utilized as not only for display purposes but also can be implemented as an image sense or a memory device to sense or memorize a number of separate images or patterns.

The device of this invention is closely similar to the single beam scanning device described in the aforementioned U.S. Pat. No. 3,408,532 involving a relatively simple modification to the structure described in that patent without any major changes in the components or assembly thereof. This patent is therefore incorporated herein by reference and only that information needed by one skilled in the art to modify the structure described within that patent will be described herein.

It is therefore the principal object of this invention to provide an improved electron beam scanning device of the general type described in U.S. Pat. No. 3,408,532 which is capable of multi-beam operation.

Other objects of this invention will become apparent as the description proceeds in connection with the accompanying drawing.

The sole FIGURE schematically illustrates one embodiment of the device of the invention.

Briefly described, the device of the invention comprises a flat plate cathode and a flat plate target having a plurality of control plates or dynodes sandwiched therebetween for controlling a plurality of electron beams. It is to be noted that the control plates need not comprise electron multipliers or dynodes. The dynodes each have a plurality of apertures formed therein such apertures being aligned with each other to form electron beam channels between the cathode and the target. The dynodes have control electrodes therein arranged in a pre-determined finger pattern, the finest finger pattern establishing a basic scanning element which defines an elemental scanning area on the target. The finger patterns are

selected and arranged so as to simultaneously provide a plurality of scanning beams. Control switching means are provided for the dynodes to selectively energize the finger pattern electrodes so as to cause each of the beams to activate a single target element at a time. A modulation grid having apertures therein corresponding to those on the control dynodes has separate control electrodes thereon, each of such electrodes being utilized for controlling one of the beams.

Referring now to the Figure, one embodiment of the device of the invention is schematically illustrated. This particular embodiment has four separate beams each of which may be caused to scan a quadrant of the target. It is to be noted that such for beam scanning in only illustrative of one of many multiple beam types of operation that can be achieved. Other numbers and arrangements of beams can be obtained by utilizing other various combinations of finger pattern electrodes and numbers of dynodes.

A power source **33** is connected between the cathode **16** and target **11** to accelerate the flow of electrons therebetween. Interposed between the cathode and target are a plurality of dynode members **22–26**. As described in U.S. Pat. No. 3,408,532, the cathode, target and dynode members are enclosed in a vacuum tight environment. The dynodes have a plurality of apertures **47** therein arranged on all of the dynodes in a similar matrix pattern. The dynodes are aligned with each other so that corresponding apertures form electron beam channels between the cathode and the target.

Dynode **22** has conductive portions **22*a*** and **22*b*** on the opposite broad surfaces thereof, these conductor portions being insulated from each other and being connected to the opposite stages of flip-flop **50**, similarly dynodes **23–25** have conductive portions **23*a***, **23*b*–25*a***, **25*b***, respectively, which are connected to corresponding flip-flops **51–53**. Modulation dynode **26** which forms a control grid has four separate electrode segments **26*a*–26*d*** on the opposite broad surfaces thereof. Each of segments **26*a*–26*d*** receives a separate modulation signal from an associated one of modulator units **60–63**.

As fully described in the aforementioned patent, the finger pattern electrodes **22*a***, **22*b*–25*a***, **25*b*** are selectively energized by their associated flip-flops **50–53** to control the electron beams between cathode **16** and target **11**. In the device of the aforementioned patent however only a single elemental portion of the target is excited at the time, as compared to the present device wherein four of such elemental portions are simultaneously excited. Such plural beam operation to provide for simultaneous beams is achieved in the illustrative embodiment shown in the figure, by eliminating both two finger control electrode dynodes of the device of the aforementioned patent and by adding modulation dynode **26** having separate electrode portions **26*a*–26*d*** for controlling each of the beams.

For the purposes of illustration, the finger pattern electrodes **22*a*—25*a*** are shown without stippling to indicate they are forward biased by their associated flip-flops so as to cause electron flow therethrough while electrodes **23*b*–25*b*** are stippled to indicate that they are back biased to retard electron flow. Assuming that each of the quadrants **26*a*–20*d*** of modulation dynode **26** are forward biased it can be seen that four beams **60*a*–60*d*** will reach target **11**. Electron flow through all other channels such as, for example, that represented by beam **61** is repelled at one or the other of the dynodes. It should be readily apparent that by appropriate driving of control flip-flops **50–53**, any elemental portion of each of the target segments can be selectively energized by its associated beam to provide either regular or random scanning.

Each of modulators **60–63** is used to provide intensity modulation signals to an associated one of control electrode portions **26*a*–26*d*** thereby producing four displays on the target, each in accordance with a separate modulation signal. As already noted, these four displays may be synthesized to form a single display or may each be a separate display in itself.

It should be readily apparent that various numbers of beams and arrangements of beam patterns can be provided by utilizing the dynodes to provide finger pattern arrangements in con-

junction with an appropriate modulation dynode for implementing the desired end result. Thus, for example an eight beam scanner could be provided by eliminating dynode **22** and providing a modulation dynode having eight segments to it.

It is of course to be understood that the 8 × 8 channel device shown in the figure is only illustrative and a practical device would normally include many more channels. It is further to be noted that in certain instances it may be desirable to provide electron multiplication dynodes which are always forward biased, particularly in situations where there are only a small number of control dynodes to produce a relatively large number of beams.

The device of this invention thus provides simple highly effective means for enabling multi-beam operation of an electron beam scanner with separate modulation beams for each of such beams.

I claim:

1. In an electron beam scanner having a plurality of beams,

a flat plate cathode,

a flat plate target,

a plurality of control plates sandwiched between said cathode and said target for controlling the flow of electrons therebetween,

each of said control plates having apertures therein, corresponding apertures on said control plates being aligned with each other to form electron channels between the cathode and target,

electrodes arranged on said control plates in predetermined finger pattern pairs,

switch means for alternatively forward biasing one or the other of the finger patterns of each of said pairs to activate a single separate channel for each of said plurality of beams at a time, and

modulation means interposed between said cathode and said target for modulating each of said beams independently.

2. The scanner of claim **1** wherein said modulation means comprises a plate having a plurality of apertures formed therein corresponding to said control plate apertures and electrode elements on said plate, each of said electrode elements being used for controlling one of said beams.

3. The scanner of claim **2** and additionally including means for providing modulating signals to each of said electrode elements.

4. The scanner of claim **3** wherein there are four beams, said modulation plate having four electrode elements, each encompassing a quadrant of said modulation means, there being at least two fingers in each of the finger patterns.

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