United States Patent [19]

Thomson

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[54] **AREA ELECTRON FLOOD GUN**

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[73] Assignee: **Northrop Corporation,** Beverly Hills, Calif.

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[52] **U.S. Cl.** **315/12,** 178/7.7, 313/67, 313/105

[51] **Int. Cl.** **H01j 29/41**

[58] **Field of Search** 178/7.7; 313/67, 313/105; 315/12

[56] **References Cited**

UNITED STATES PATENTS

3,408,532	10/1968	Hultberg et al.	315/12
3,483,422	12/1969	Novotny	315/12
3,505,559	4/1970	Jeffries et al.	315/12

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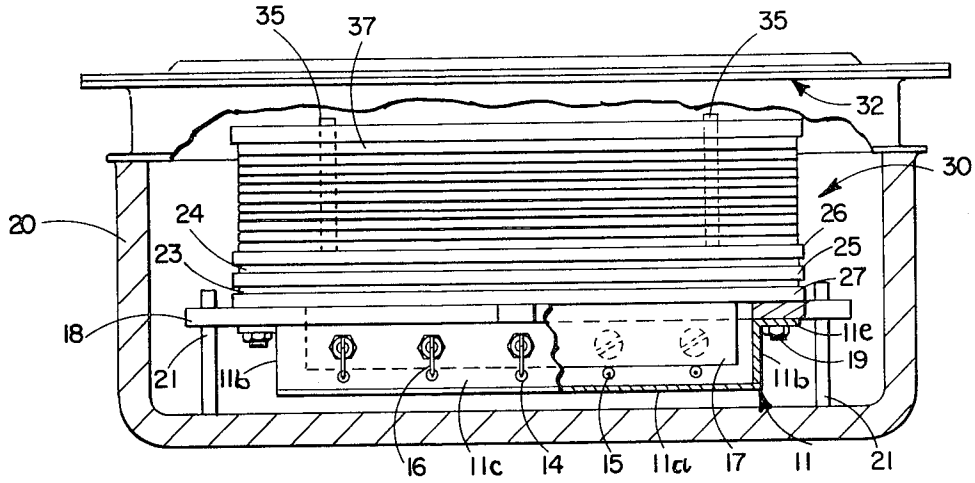
[57] **ABSTRACT**

A plurality of strip filaments provide a source of electrons. A deflector electrode in the form of a flat dish is placed behind the filaments, and director electrodes which may be in the form of wire meshes, are placed forward of the filaments in the direction in which the electron flow is desired. Additional electrodes which may be in the form of narrow plates are placed along the ends of the filaments to compensate for fall-off in emission at the filament extremities. The various electrodes are positioned relative to the filaments and have potentials applied thereto such that the uniform distribution of electrons is provided over a predetermined area throughout which electron flow is desired.

6 Claims, 4 Drawing Figures



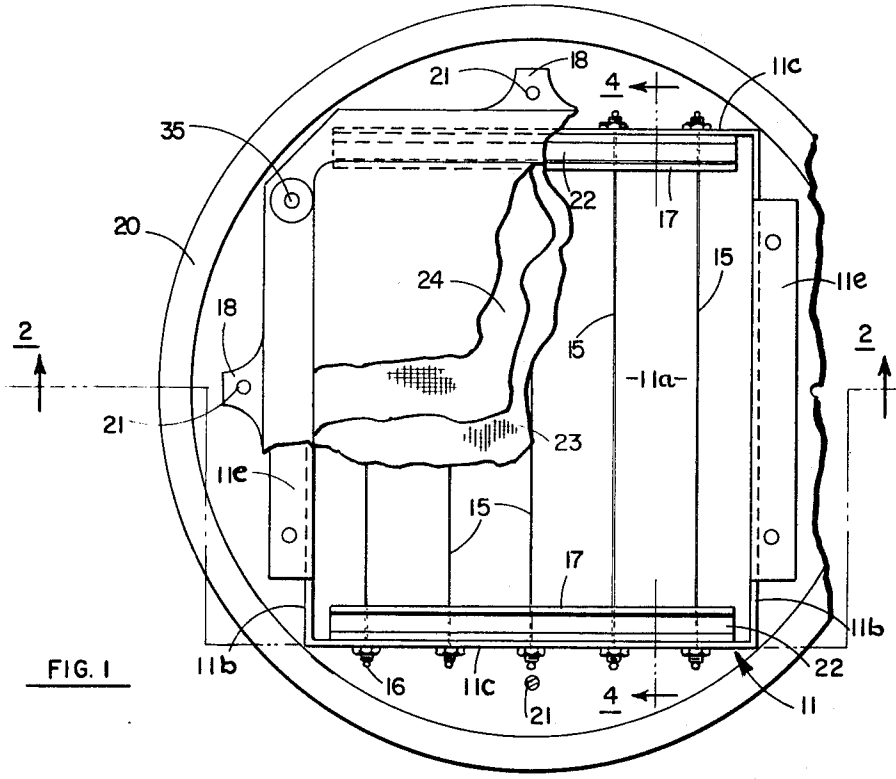


FIG. 1

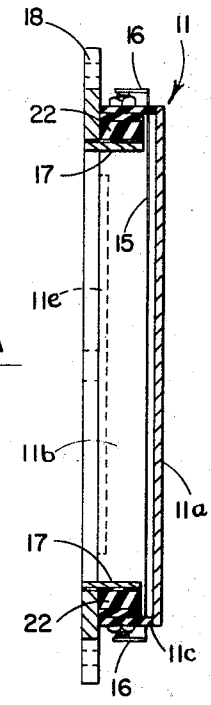


FIG. 4

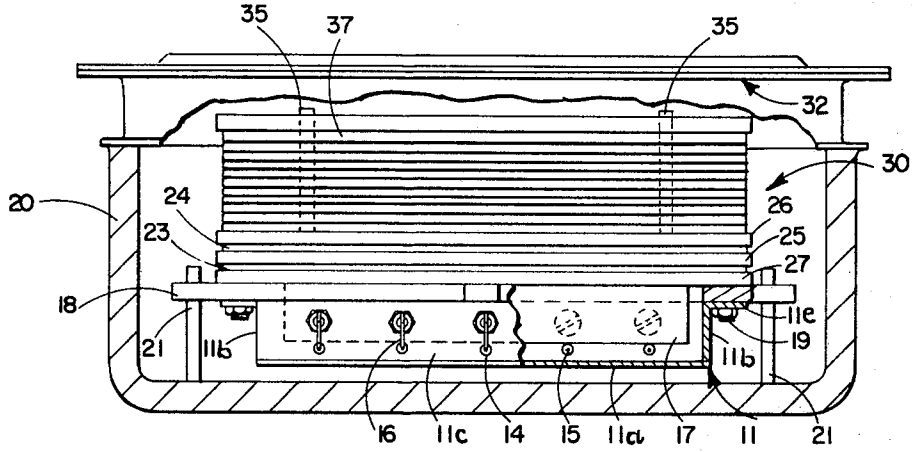


FIG. 2

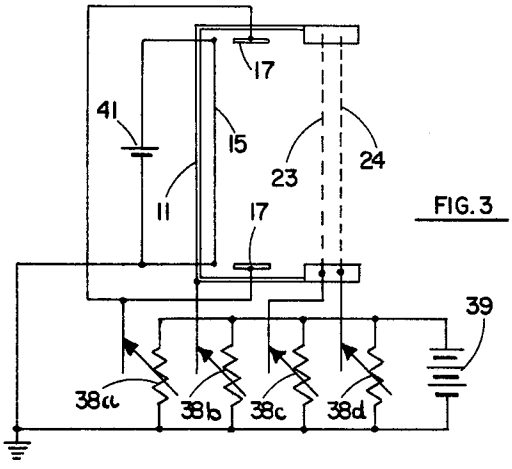


FIG. 3

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AREA ELECTRON FLOOD GUN

This invention relates to electron guns, and more particularly to such a gun capable of distributing electrons emitted from a strip filament uniformly over a predetermined area.

In an area electron beam scanner such as described in U.S. Pat. No. 3,408,532, issued Oct. 29, 1968, and assigned to Northrop Corporation, it is necessary to provide a source of electrons which is uniformly distributed over a predetermined area. Devices of the prior art for providing such an area electron source have included the use of radioactive or photoemissive surfaces and thermionic area filaments or indirectly heated cathodes.

The photoemissive type cathodes generally have too low an electron yield to provide proper operation of an area display device and due to their dependency on incident light, are limited to situations where the device is to be operated at all times in an area having an ambient light source.

Radioactive type cathodes carry with them the hazards of radioactive exposure. They also are relatively high in cost and have relatively low electron yield if they are kept within safe radiation limits. This type of cathode also tends to generate gases which adversely affect the vacuum environment needed in the electron beam device with which the cathode is utilized.

Area heated filaments and indirectly heated cathodes encompassing a fairly broad area generally require a large amount of heat energy to provide an adequate electron yield. This involves large power requirements and undesirable heat dissipation. Also, with indirectly heated cathodes it is often difficult to get uniformity of electron emission over the cathode surface area.

The device of this invention overcomes the shortcomings of prior art area cathodes by enabling the utilization of thermionic strip filaments as the electron source, thus obviating the disadvantages of radioactive and photoemissive cathodes. An area electron flow is developed from the strip filaments by means of appropriately placed and biased electrode members to provide a uniform electron supply over a predetermined desired area. In this manner, significant heat energy is only generated in the small area encompassed by the strip filament so that there is substantially lower power consumption and heat dissipation than involved with indirectly heated cathodes and wide area filament devices. Further, the device of this invention enables the more uniform distribution of the electrons over the desired emission area than possible with prior art devices.

It is therefore the principal object of this invention to provide an improved area electron flood gun involving an efficient utilization of power and which is capable of providing a uniform distribution of electrons over a predesired area.

Other objects of this invention will become apparent as the description proceeds in connection with the accompanying drawings of which:

FIG. 1 is a front elevational view with partial cutaway section of one embodiment of the device of the invention,

FIG. 2 is a cross-sectional view taken along the plane indicated by 2—2 in FIG. 1,

FIG. 3 is a schematic drawing illustrating the electrical circuit of the embodiment of FIG. 1, and

FIG. 4 is a cross-sectional view taken along the plane indicated by 4—4 in FIG. 1.

Briefly described, the device of the invention comprises a plurality of electron emitting filaments in the form of elongated wires or strips with a conductive electron deflector electrode generally in the form of a flat dish which is positioned behind the filaments, and one or more electron director electrodes generally in the form of a conductive wire mesh or screen positioned in front of the filament, i.e., in the direction from the filaments in which the flow of electrons is desired. Additionally, a pair of elongated electrodes are positioned along the ends of the filaments to improve the uniformity of the distribution of electrons emitted thereby. The various electrodes are positioned, shaped and have potentials placed thereon such as to provide a uniform flow of electrons over a predetermined area and in a desired direction.

Referring now to FIGS. **1**, **2** and **4**, one embodiment of the device of the invention as incorporated into an electron beam scanner of the type described in the aforementioned U.S. Pat. No. 3,408,532, is illustrated. Deflector electrode **11** is in the form of a flat dish having a flat surfaced back portion **11***a* and side portions **11***b* and **11***c* (portions **11***c* being of insulating material) extending perpendicularly from portion **11***a*. Running along the perimeter of the mouth portion of the dish are flanges **11***e*, these flanges being attached to support plate **18** by means of bolts **19.** Suspended between the end wall portions **11***c* of dish **11** are filaments **15,** these filaments being spring tensioned and supported by filament leads **16** and passing through holes **14** in insulating wall portions **11***c*. A power source **41** (see FIG. **3**) is connected to filament leads **16** to heat the filaments **15** to cause emission of electrons therefrom.

Support plate **18** is utilized to support the entire assembly in casing **20** and is attached to the casing by means of rods **21.** Electron directing electrodes **23** and **24** are in the form of wire meshes or screens which are mounted in insulator frames **25** and **26** respectively. Frames **25** and **26** act as insulative separators between the edges of the meshes. Insulative separator frame **27** acts to separate mesh **23** from support plate **18.** Supported on support plate **18** in front of electrodes **23** and **24** is electron beam scanner assembly **30** which includes a plurality of beam control plates **37** sandwiched between the target and the cathode. A phosphor target **32** is on the inside of the casing positioned opposite the last of control plates **37.** As already noted, this assembly may be similar to that described in U.S. Pat. No. 3,408,532. Casing **20** is suitably evacuated to provide a vacuum environment for the flow of electrons. Electron beam scanning assembly **30** as well as electron directing electrodes **23** and **24** are held to support plate **18** by means of insulating rods **35.**

A pair of elongated flat electrode plates **17** are positioned along each of the ends of filaments **15,** these plates extending away from the filaments to a position opposite the forward edge of support plate **18.** Plates **17** are supported on insulative end wall portions **11***c* of dish electrode **11** and insulated bar portions **22.** Plates **17** are joined to wall portions **11***c* and bar portions **22** by suitable means such as bolting.

Referring now to FIG. **3** a schematic drawing of the electrical connections to the various electrodes and the filaments is shown. Filaments **15** are maintained essentially at ground potential and are heated by a suitable power source to provide electron emission. Voltage divider **38** receives a potential thereacross from power

source **39**. Successively higher potentials are applied from voltage divider **38** to dish electrode **11**, screen electrode **23** and screen electrode **24**. End electrodes **17** receive a predetermined positive potential from power source **38***a*. The potentials applied to the various electrodes are selected so as to cause the electrons emitted by filaments **15** to be accelerated towards screens **23** and **24** and distributed uniformly over the area encompassed by these screens.

The electrons are deflected by dish shaped electrode **11** but for the most part prevented from impinging on the inner walls of this electrode in view of the effect of higher electrostatic fields provided by electrodes **23** and **24**. Electrodes **17** by virtue of the positive potentials applied thereto act to compensate for the lower electron output at the ends of the filaments, due to the heat sink cooling effect on such ends imparted by the metallic structure proximate thereto. Thus, electrodes **17** tend to attract electrons to the filament ends, thereby enhancing the uniformity of the electron distribution.

In an operative model of the device of the invention, utilizing five filaments as shown in the embodiment of FIG. **1**, the dish member **11** is three-eighth inches deep, the filaments are spaced 0.062 inches from the back wall **11***a* of the dish, and the following electrode voltages were utilized:

Dish electrode **11**	19.5 volts
Side electrodes **17**	29 volts
Screen **23**	106 volts
Screen **24**	115 volts

These are of course only one example of electrode voltages with which successful results have been obtained. For each particular design, optimum parameters can readily be obtained empirically.

The device of this invention thus provides a highly effective means for generating a source of electrons which is uniformly distributed over a predetermined area.

I claim:

1. An electron flood gun for providing a uniform flow of electrons over a predetermined area comprising:

elongated filament means for generating electrons,

deflector electrode means in the form of a flat dish in which said filament means is positioned,

director electrode means placed proximate to said filament means in a direction therefrom towards which the flow of electrons is desired, said director electrode means having a surface area substantially equal to the area over which the electron flow is desired, and

means for applying successively higher potentials than that on said filament means to said deflector electrode means and said director electrode means respectively, whereby the electrons from said filament means are accelerated through said director electrode means and arranged in a substantially uniform pattern over the predetermined flow area.

2. The device of claim **1** wherein said director electrode means is in the form of at least a single wire mesh.

3. The device of claim **1** wherein said director electrode means comprises first and second wire meshes arranged in series relationship in the direction of desired electron flow, said meshes having successively higher potentials applied thereto.

4. The device of claim **2** wherein said filament means comprises a plurality of separate filaments arranged in parallel relationship within said dish, said dish having a flat surfaced back portion and side portions extending perpendicularly from said back portion, said filaments being suspended between opposite side portions of the dish.

5. The device of claim **1** additionally including electrode means positioned along the end portions of the filament means, and further including means for applying a potential to said last mentioned electrode means to draw electrons to the ends of said filament means so as to compensate for end cooling of the filaments.

6. The device of claim **4** and further including additional electrode means in the form of elongated plate members positioned along the end portions of said filaments and extending from said filaments towards said director electrode means, and means for applying a potential to said additional electrode means so as to provide additional electrons at the ends of said filaments to compensate for cooling at said ends.

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