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Beeli

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[54] STORAGE TUBE CONSTRUCTION

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[52] **U.S. Cl.** **313/65**, 313/105, 313/95

[51] **Int. Cl.** **H01j 31/26**

[58] **Field of Search** ..... 313/65, 65 A, 65 T, 67, 72, 313/81, 95, 105; 315/11

[56] **References Cited**

UNITED STATES PATENTS

3,426,235	2/1969	Schade, Sr.	315/11
2,249,494	7/1941	Ramo	313/72
2,740,919	4/1956	Fleming	315/15
2,821,643	1/1958	Morton	313/67
3,035,197	5/1962	Turk	313/65
3,303,373	2/1967	Alting-Mees	313/65
3,315,109	4/1967	Musselman	313/65

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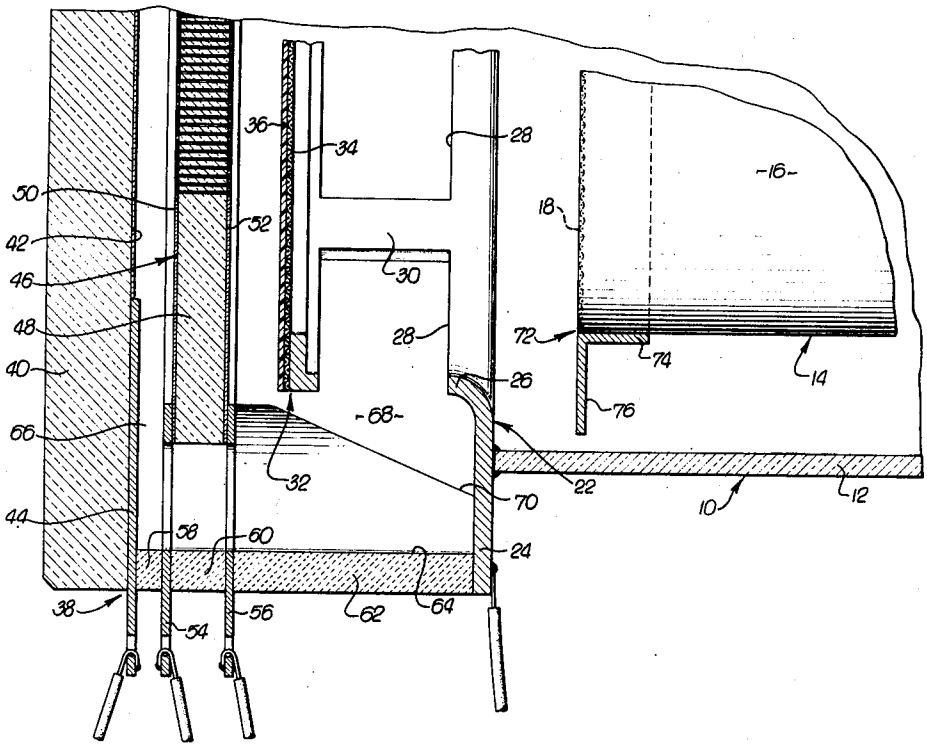
[57] **ABSTRACT**

A television camera-type storage vacuum tube wherein a channel-type electron multiplier and the storage target are mounted on support structure which is apertured to reduce photo cathode-to-target capacitance, electron multiplier-to-target capacitance, and target-to-electron gun capacitance; and annular light shield means interposed between the electron gun and apertured support structure to prevent light emanating from the cathode heater of the electron gun from penetrating through the support structure to the photo multiplier section of the tube. The reduced capacitance produces improved frequency response of the tube, while the light shield means cooperates to preserve low light level performance and hence good contrast, resolution and sensitivity of the tube.

11 Claims, 3 Drawing Figures



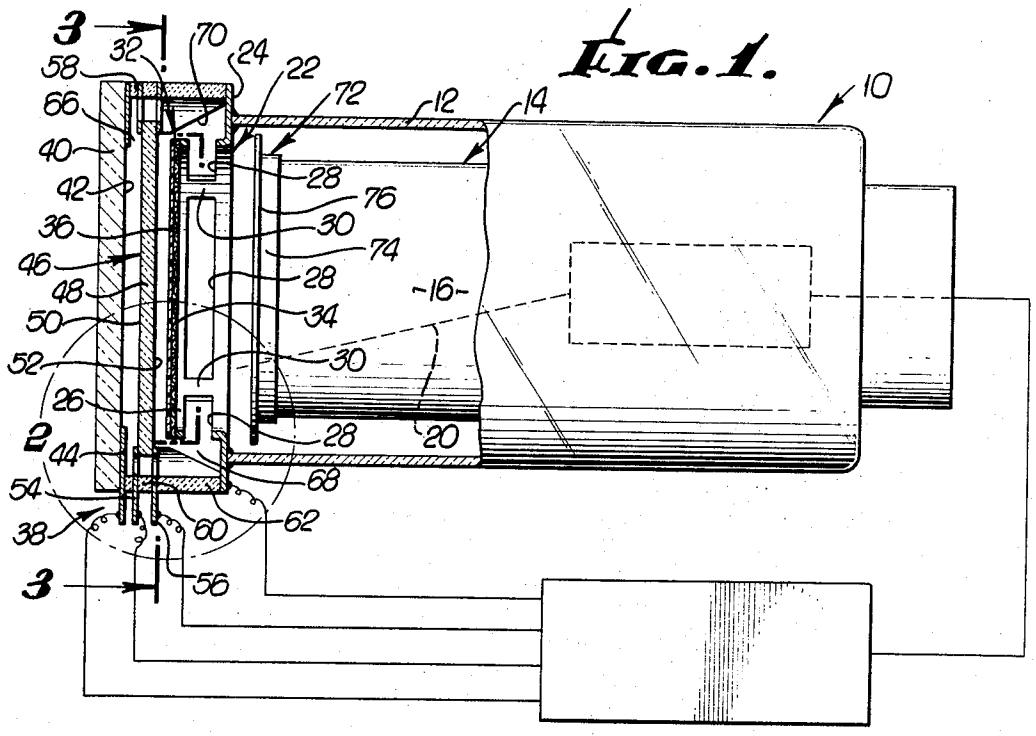


FIG. 1.

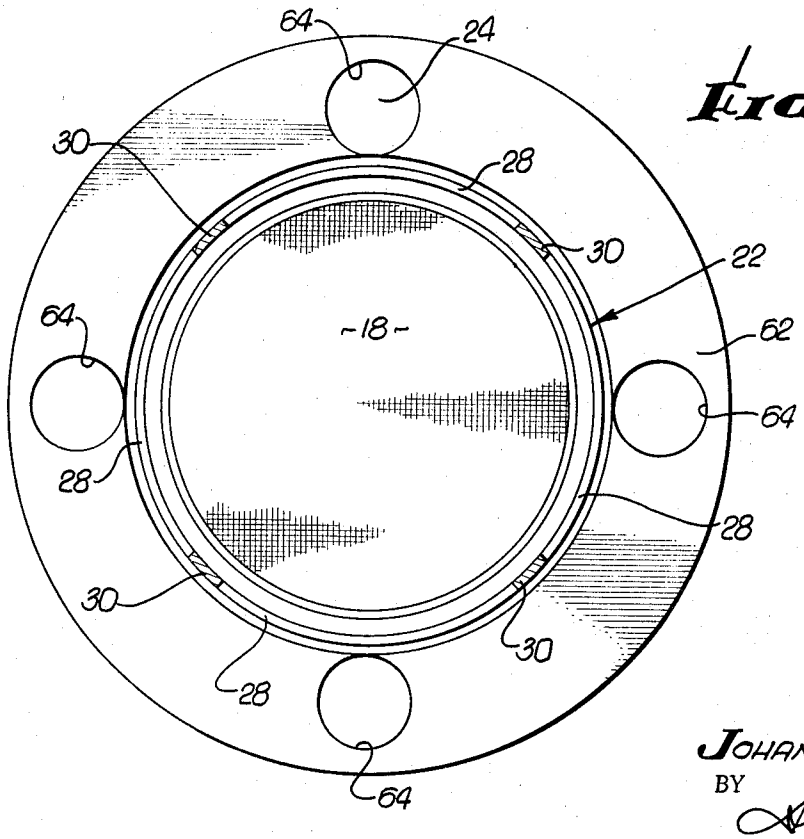


FIG. 3.

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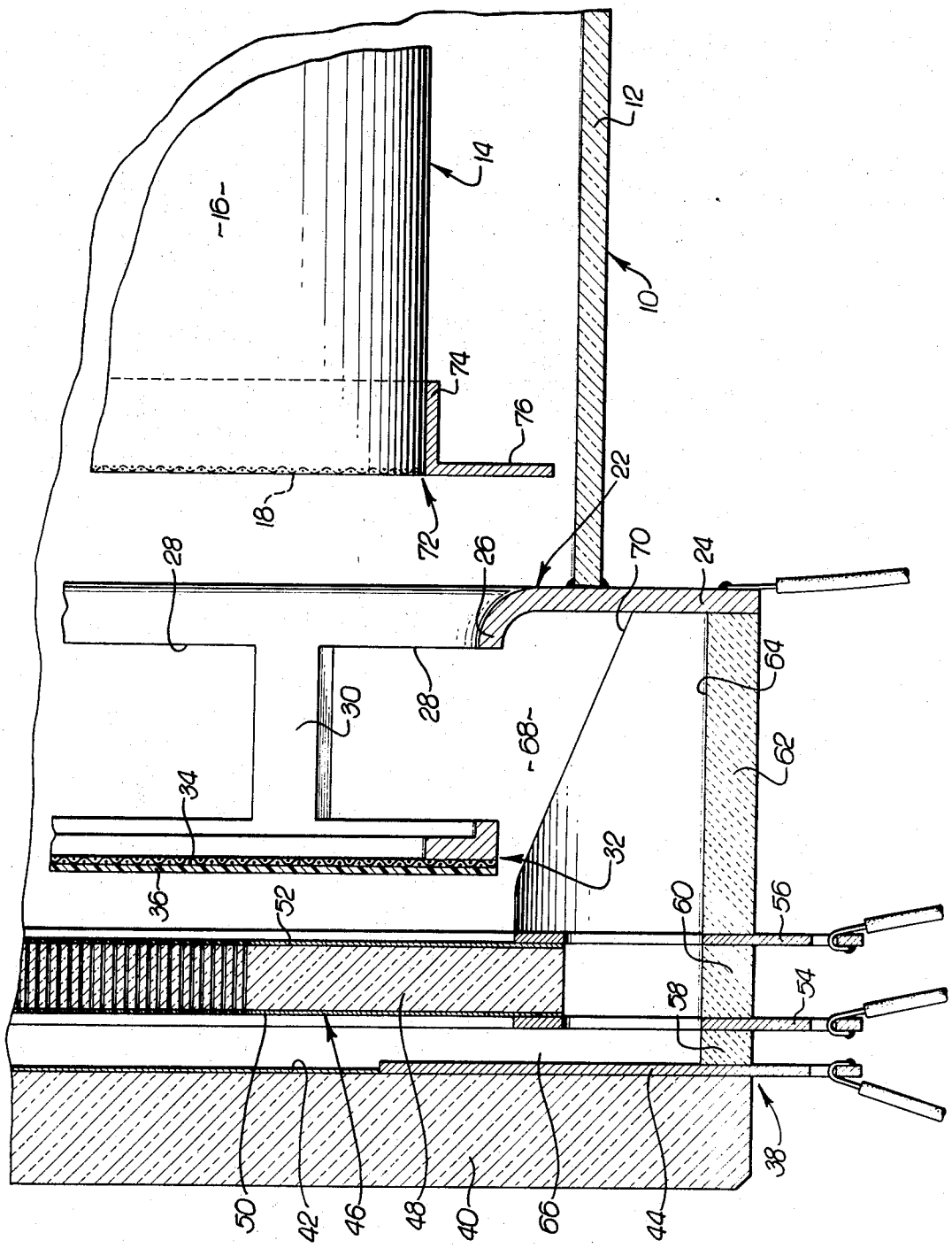

FIG. 2.

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STORAGE TUBE CONSTRUCTION

BACKGROUND OF THE INVENTION

The present invention relates to the storage tube art, and more particularly to storage tubes of the type wherein photo multiplication is accomplished by means of a channel-type electron multiplier interposed between the photocathode and the storage target. The storage target and electron multiplier are each generally in the shape of a disc, and these two discs must be supported parallel to each other and to the photocathode, as well as in axial alignment with and forwardly spaced from the electron gun forming a part of the storage tube.

Such mounting of the storage target and electron multiplier must be highly stable, for uniform, predictable tube performance. Typically, the storage target will be mounted upon a metal tube or ring over which the target is stretched, while the electron multiplier, which is a rigid, disc-shaped structure, is peripherally supported by one or more annular ceramic insulator members stacked forwardly of and in axial alignment with the metal ring which supports the target. Such annular ceramic insulator members have good structural stability and insulating qualities, so that they can abut directly against the metal holder for the target for accurate positioning of the electron multiplier relative to the target, while maintaining a good electrical insulation barrier therebetween.

It is conventional practice to provide the metal storage target support as a solid or closed sleeve, and also to provide the annular ceramic insulator supports for the electron multiplier as solid or closed annular members. While the structural strength and stability of such solid or closed support means for the target and electron multiplier may be adequate, the applicant has found in practice that such support members have the effect of increasing the capacitive relationship between some of the functional parts of the tube, with the result that frequency response of the tube is impaired. Thus, the applicant has found that the solid or closed metal sleeve which supports the target produces undesirable photo cathode-to-target and target-to-electron gun capacitances which adversely affect the frequency response of the tube. Similarly, the applicant has found that the conventional solid or closed annular insulators employed to support the electron multiplier detract from the desired frequency response of the tube by producing undesirable multiplier plate-to-target capacitance.

SUMMARY OF THE INVENTION

According to the present invention, the metal sleeve or ring which serves as a support for the storage target in a vacuum tube of the character described is apertured so as to be in the form of a webbed annular structure, thereby substantially reducing photo cathode-to-target and target-to-electron gun capacitance, and improving the frequency response of the tube. Preferably, the apertures are provided in an annular, symmetrical array about the target support. Also, such apertures in the target support are preferably oriented generally in the radial direction.

Similarly, according to the present invention the annular ceramic insulator means which serves to peripherally support the electron multiplier plate is apertured, preferably in annular, symmetrical array of apertures which are oriented principally in the axial direction of the tube. This reduces multiplier plate-to-target capacitance, thereby cooperating with the apertured target support to further improve the frequency response of the tube.

A further feature of the present invention is the provision of an annular light shield proximate the forward end of the electron gun and interposed between the electron gun and said apertured support structures for the storage target and electron multiplier plate so as to prevent light from the cathode heater of the electron gun from penetrating through the apertured support structures to the photo multiplier section of the tube. Thus, the annular light shield serves to preserve the low light level performance, and hence the contrast, resolution and sensitivity of the tube.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which are to be regarded as merely illustrative,

FIG. 1 is a side elevational view, partly in section, of a storage tube constructed in accordance with the present invention;

FIG. 2 is an enlarged sectional detail view of a portion of FIG. 1, illustrating further structural details of the invention; and

FIG. 3 is a transverse section taken on the line 3—3 in FIG. 1.

DETAILED DESCRIPTION

Referring to the drawings, a storage tube embodying the present invention is indicated generally as **10**, and includes an evacuated glass envelope **12**. An electron gun is generally designated **14**, and includes a tubular shell portion **16** having a suppressor grid **18** at its forward end as shown in FIG. **2**. The electron gun **14** produces a scanning beam **20** of electrons.

A support ring **22** is connected to the forward end of the envelope **12**, and includes a generally flat, circular portion **24** projecting radially outwardly as a flange from the forward end of envelope **12**, and a tubular target support sleeve portion **26** upon which the storage target is supported. In accordance with the present invention, this sleeve portion **26** of the support ring **22** is provided with an annular, symmetrical array of radially directed apertures **28** which are separated by remaining intermediate web portions **30** of the target support sleeve **26**.

The storage target **32** is stretched across the forward edge of the support sleeve **26**, and may, if desired, be attached to a holder ring **33** which is in turn attached to the forward edge of the target support sleeve **26**. The storage target **32** is a laminar structure composed of a fine metal screen **34** on the rearward side thereof which is scanned by the beam **20** of electrons, and a dielectric sheet **36**, which is conventionally opaque, on the forward side thereof upon which an image is electrically stored.

The photo multiplier is generally designated **38**, and is disposed forwardly of the storage target **32**. Photo multiplier **38** includes a glass face plate **40** having an evaporated photocathode **42** disposed on its rearward face, with a conductor ring **44** in electrical contact with the periphery of the photocathode **42**.

Disposed between the photo cathode **42** and the storage target **32** is channel-type electron multiplier **46**. The multiplier **46** includes an axially perforate, disc-shaped glass body **48** having evaporated electrodes **50** and **52** on its forward and rearward surfaces, respectively, through which the perforations extend. Conductor rings **54** and **56** are in contact with peripheral portions of the respective evaporated electrodes **50** and **52**.

The face plate **40** and electron multiplier plate **48** are supported in properly spaced, parallel relationship with respect to each other and to the storage target **32** by means of a series of annular ceramic insulators **58**, **60** and **62**. The forwardmost of these three annular ceramic insulators, the insulator **58**, spaces the glass face plate **40**, and hence the evaported photocathode **42**, forwardly from and parallel to the electron multiplier **46**. Since the annular insulator **58** serves simply as a spacer, it can be relatively thin in the radial direction, and located proximate the outer periphery of the photo multiplier **38**, and hence does not introduce adverse capacitive effects which materially detract from the frequency response of the tube.

The intermediate ceramic insulator **60** serves to peripherally support and position the disc-shaped glass body **48** of the electron multiplier **46**, and is preferably more extensive in the radial direction than the spacer insulator **58**.

The rearwardmost of the three annular ceramic insulators, the target insulator **62**, is the principal means of support for the electron multiplier **46**, and because of the substantial spacing between the flat portion **24** of the target support ring **22**,

and the weight of the photo multiplier **38**, is required to be rather substantial in size both radially and axially.

According to the present invention, the annular ceramic insulator means which includes both the multiplier insulator **60** and the target insulator **62** is apertured with an annular, symmetrical array of axially oriented apertures **64** which extend and provide communication from the space **66** between the photocathode **42** and the electron multiplier **46** on the one hand and the space **68** between electron multiplier **46** and the flat portion **24** of support ring **22** on the other hand. Such communication with the rearward space **68** is permitted by providing a rearwardly and outwardly flaring bevel **70** on the inside of the target insulator **62**, the bevel **70** intersecting the apertures **64**.

The annular light shield is generally designated **72**, and for convenient mounting may include a cylindrical collar **74** engaged about the forward end of the electron gun shell **16**. The light shield **72** further includes generally radially outwardly extending annular flange **76** which serves the light-shielding function. The light shield is interposed between the electron gun and the apertured support structure including the support ring **22**, target insulator **62** and multiplier insulator **60**, and is so positioned as to prevent light from the cathode heater of the electron gun from penetrating through the support structure to the photo multiplier section **38** of the tube.

The provision of the generally radially directed apertures **28** in the target support sleeve portion **26** of the ring **22** substantially reduces photo cathode-to-target and target-to-electron gun capacitance, while the provision of the generally axially oriented apertures **64** in the multiplier and target ceramic insulators **60** and **62**, respectively, substantially reduces the multiplier plate-to-target capacitance; while at the same time the light shield **72** preserves the low light level performance of the tube. The net result is that the storage tube constructed in accordance with the present invention has substantially improved frequency response, and good contrast, resolution and sensitivity.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, the invention is of course not limited to that specifically described. Many changes and modifications of the invention will suggest themselves to those skilled in the art. The true scope of the invention is therefore defined only in the appended claims.

What is claimed is:

1. In a storage tube having a storage target member, an electron gun disposed rearwardly of the target member and providing a beam of electrons which scans an area of said target member, a photocathode disposed forwardly of said target member, and a channel-type electron multiplier plate member interposed between said photocathode and said target member; annular support structure for at least one of said members which is apertured to reduce capacitance between said target member and other parts of the tube and thereby improve the frequency response of the tube.

2. The invention as defined in claim **1**, wherein said support structure is apertured with a symmetrical, annular array of apertures.

3. The invention as defined in claim **1**, wherein said support structure includes a metal target support ring having an apertured, generally cylindrical sleeve portion, the target member being mounted on said sleeve portion proximate the front thereof, said ring including a flange portion extending generally radially outwardly from said sleeve portion proximate the rear thereof, and annular multiplier plate support means comprising at least one ceramic ring extending forwardly from said flange portion of the ring and peripherally supporting said multiplier plate member, said sleeve portion of the target support ring being provided with generally radially oriented apertures and said ceramic ring being provided with generally axially oriented apertures.

4. The invention as defined in claim **1**, which includes annular light shield means in the tube interposed between the electron gun and said apertured support structure so as to prevent light from the cathode heater of the electron gun from passing forwardly through said apertured support structure to the region in the tube proximate the photocathode.

5. The invention as defined in claim **1**, wherein said support structure includes an apertured, electrically conductive target support ring.

6. The invention as defined in claim **5**, wherein said ring has a generally cylindrical sleeve portion upon which said target member is supported, said sleeve portion being apertured with generally radially oriented apertures.

7. The invention as defined in claim **1**, wherein said support structure includes apertured electrically insulative multiplier plate support means.

8. The invention as defined in claim **7**, wherein said plate support means is apertured with generally axially oriented apertures.

9. An electron tube comprising: an envelope; an electron gun having a thermionic cathode in said envelope; a photocathode fixed relative to said envelope; and a light shield fixed relative to said envelope in a position for intercepting light emanating from said cathode to prevent said light from illuminating said photocathode, wherein said tube has an axis extending generally from said cathode toward said photocathode, said light shield extending generally in an outward radial direction from said axis toward said envelope, said shield being located inside said envelope, and an opaque auxiliary member extending from said envelope radially inwardly therefrom, the inner edge of said auxiliary member being located at a radius from said axis smaller than the outer edge of said shield in a manner to cause interception of light traveling in an axial direction from said cathode by at least said shield or said member.

10. The invention as defined in claim **9**, wherein said member is an apertured disc having circular concentric inner and outer radial edges, and a side surface in a plane perpendicular to said axis, said envelope being bonded to said side surface intermediate said edges, said shield including a radial flange having an outer circular edge concentric with said member edges, all of said circular edges having said tube axis as an axis of symmetry.

11. The invention as defined in claim **10**, wherein said tube is a low light level tube for receiving light at levels below which objects are not clearly visible to the naked eye, said tube being adapted to intensify images at said low light levels so that they are visible to the naked eye.

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