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EXTENDED FLOOD BEAM SOURCE FOR IMAGE TUBES

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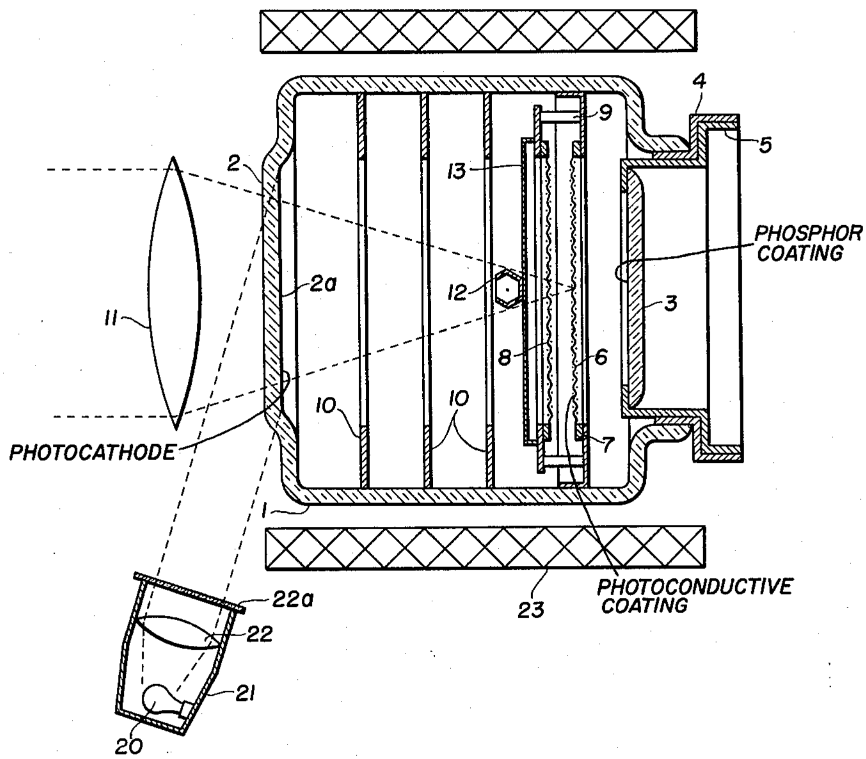

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EXTENDED FLOOD BEAM SOURCE FOR IMAGE TUBES

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This invention relates to electron image tubes and is particularly directed to an improved source of flood electron beams.

Image tubes for amplifying the brightness of an optical image or for converting an image from one wavelength region to another may comprise a luminescent plate, a control screen mounted parallel to and closely spaced from the plate, and an electron source. If the control screen is coated on one side with a photoconductive layer, whose front-to-back electrical conductivity in any small area becomes a function of the local incident radiation, then the optical image to be amplified or converted may be projected directly onto the control screen. A collimated flood source yields a uniform parallel extended beam of electrons which approaches the control screen and is locally reflected or transmitted through the interstices of the screen, according to the pattern of conductivity and hence of electrical potential on the exposed photoconductive surface of the screen; the transmitted portions of the beam then selectively activate the phosphor elements of the luminescent plate. In this type of tube, the uniform quality of the resultant image on the plate depends importantly on the uniformity of the flood beam.

Heretofore, the flood beam has been produced by a thermionic cathode with an electrostatic accelerating and collimating system. Unless the flood beam is perfectly collimated and uniformly floods the control screen, the resulting picture is imperfect. Such flood beams are particularly vulnerable to outside electrostatic and electromagnetic disturbances.

An object of this invention is an improved image tube.

A more specific object of this invention is an image tube having an improved flood beam source.

The objects of this invention are attained by an image tube having a luminescent plate, an electron perforate control screen, and an extended electron source serially arranged in parallel planes in a hermetically sealed envelope, said screen being responsive to a pattern of incident radiant energy to admit controlled and selective amounts of electrons through interstices in various areas of said screen to said plate; said electron source comprising a planar photocathode and a light source disposed to illuminate the photocathode uniformly. Since the control screen is coated with a photoconductive layer, the mentioned light source should preferably be of a wavelength region to which the photoconductive layer is insensitive.

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawing, wherein the single figure shows in longitudinal section a tube embodying this invention.

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Referring to the drawing, the envelope **1** is generally tubular in shape, closed at one end by the clear glass window or plate **2**. At the opposite end of the envelope, there is sealed a second clear glass plate **3**. Glass-to-metal seals are convenient in manufacture of tubes of this type. The end of the envelope may be sealed to the ring **4** having the proper co-efficient of thermal expansion to unite well with the particular glass of the envelope and the perimeter of the plate **3** is likewise sealed to the metal annulus **5**. The annuli **4** and **5** may then be brazed, soldered or welded gas tight. The exhaust tubulation is not shown.

The inner surface of plate **3** is coated with a phosphor which will luminesce when bombarded with electrons. It is usually protected by an evaporated layer of aluminum, which may be penetrated by electrons but not by radiation.

Immediately in front of and parallel with plate **3** is mounted the control screen **6**. The peripheral edges of the screen are welded or otherwise attached to ring **7** which is in turn supported upon the envelope **1**. Screen **6** is of a fine mesh and preferably has 500 to 1,000 wires per inch in either direction. Approximately 50% open area is desirable. The forward face of the control screen, the left-hand side in the drawing, is coated with a photoconductive layer. The thickness of the layer is of the order of a few microns; it is composed of a mixture or compound which changes conductivity in response to a limited range of wavelengths of radiant energy. In the near infra-red range, the sulphides of lead and thallium may be used. On the other hand, materials which are sensitive to visible radiation include germanium sulphide, selenium and antimony sulphide. Photoconductor layers have been made with combined bismuth sulphide and selenium. Generally, the most effective method of application of the photoconductive layer to the screen is by evaporation in vacuum or in a controlled low-pressure atmosphere.

The collector screen **8** is placed parallel to and immediately in front of the control screen and may be mounted on stand-off insulators **9** from the supporting ring **7** of the control screen. Concentric with the axis of the tube is mounted the series of spaced accelerating rings **10**.

The inner surface **2***a* of the plate window **2** is coated with a metal which will emit electrons when irradiated with light. The metal chosen should be selectively insensitive to the wavelength region of the image to be received, and should be most sensitive to a wavelength region well removed from the incoming image wavelengths. Barium metal, for example, emits electrons copious in an electrostatic field when irradiated by an ultra-violet source but is insensitive to infra-red, hence barium and similar metals are preferred where the image to be received is in the infra-red range.

The image to be received is focused by any suitable optical system and is shown diagrammatically being focused on the control screen **6** by the lens **11**.

The metal for the photocathode **2***a* may be conveniently laid down on the plate by evaporation from the metal cup **12**, mounted on one leaf of the shutter **13** near the tube axis. Inasmuch as the phosphor of plate **3**, and the photoconductor on screen **6** are often incompatible with and poisonous to the photocathode materials of plate **2***a*, it has been found desirable to partition the envelope into two chambers during manufacture; for this purpose, the shutter **13**, which may be closed during evaporating steps, is placed across the envelope. The shutter is opened after the tube has been completed and sealed off.

According to an important feature of this invention, the light source **20** and an optical system including a light-tight hood **21**, a lens **22** and an ultra-violet transmitting filter **22**a are so disposed as to illuminate uniformly the photocathode **2**a. The light source **20** is selected for its spectral properties so that none of the radiation therefrom will activate the photoconductive layer.

In operation, the incoming optical image of, say, infrared light is focused by lens **11** upon the photoconductive control screen **6**. Discrete elements of the screen are selectively made positive in those areas which are illuminated. The remaining "dark" areas remain less positive, or negative. Irradiation of the photocathode from light source **20** produces an extended uniform source of electrons from the entire area of the photocathodes **2**a, which electrons are accelerated by accelerators **10** and by the positive potential on collector screen **8** and approach the control screen **6** normally, along parallel lines, by virtue of the action of the longitudinal magnetic field from focusing coil **23**.

The problem of collimating a flood beam from a point source of electrons is effectively obviated by this invention.

While we have described above the principles of our invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of our invention.

What is claimed is:

1. An image tube comprising electrodes including a phosphor electrode, an electron permeable control screen with a photoconductive layer, said control screen being spaced from said phosphor electrode, a photocathode spaced from said control screen on the side opposite said phosphor electrode, a window, said photoconductive layer facing said window whereby radiation passing through said window falls on said photoconductive layer, said photocathode disposed between said window and said photoconductive layer, said photoconductive layer and the photocathode being responsive to light predominantly in different regions of the light spectrum.

2. In an image tube: an envelope; a photosensitive, electron permeable control screen positioned in said envelope; a window in said envelope being arranged for projection of a radiation image having a first wavelength region therethrough onto said control screen; a photoemissive cathode disposed in the space between said window and said control screen; and a source of radiation having a second wavelength region removed from said first wavelength region; said radiation source being arranged to illuminate said photocathode; said photocathode being sensitive to said second wavelength region and insensitive to said first wavelength region whereby said radiation image passes through said photocathode onto said control screen without causing emission of electrons therefrom and said radiation source causes emission of electrons from said photocathode for flooding said control screen.

3. In an image tube: an envelope; a photosensitive, electron permeable control screen positioned in said envelope; one end of said envelope being arranged for projection of a radiation image having a first wavelength region therethrough onto said control screen; a photoemissive cathode disposed in said envelope between said one end and said control screen and being spaced from said control screen; and a source of light on the exterior of said envelope and having a second wavelength region removed from said first wavelength region; said light source being arranged to illuminate said one end of said envelope and said photocathode; said photocathode being sensitive to said second wavelength region and insensitive to said first wavelength region whereby said radiation image passes through said photocathode onto said control screen without causing emission of electrons therefrom and said light source causes emission of electrons from said photocathode for flooding said control screen.

4. In an image tube: an envelope; a photosensitive electron permeable control screen positioned in said envelope; one end of said envelope being arranged for projection of a radiation image having a first wavelength region therethrough onto said control screen; a photoemissive cathode disposed in said envelope between said one end and said control screen and being spaced from said control screen; and a source of light on the exterior of said envelope and having a second wavelength region removed from said first wavelength region, said light source being arranged to produce illumination obliquely incident upon said one end of said envelope and said photocathode; said photocathode being sensitive to said second wavelength region and insensitive to said first wavelength region whereby said radiation image passes through said photocathode onto said control screen without causing emission of electrons therefrom and said light source causes emission of electrons from said photocathode for flooding said control screen.

5. In an image tube: an envelope; a photosensitive, electron permeable control screen positioned in said envelope; one end of said envelope being arranged for projection of a radiation image having a first wavelength region therethrough onto said control screen; a photoemissive cathode disposed in said envelope between said one end and said control screen and being spaced from said control screen; and a source of radiation having a second wavelength region removed from said first wavelength region; said radiation source being arranged to illuminate said photocathode; said photocathode being sensitive to said second wavelength region and insensitive to said first wavelength region whereby said radiation image passes through said photocathode onto said control screen without causing emission of electrons therefrom and said radiation source causes emission of electrons from said photocathode for flooding said control screen; said control screen being insensitive to said second wavelength region.

6. In an image tube: an envelope; a photosensitive, electron permeable control screen positioned in said envelope; one end of said envelope being arranged for projection of a radiation image having a first wavelength region therethrough onto said control screen; a photoemissive cathode disposed in said envelope, between said one end and said control screen and being spaced from said control screen; a source of radiation having a second wavelength region removed from said first wavelength region; said radiation source being arranged to illuminate said photocathode; said photocathode being sensitive to said second wavelength region and insensitive to said first wavelength region whereby said radiation image passes through said photocathode onto said control screen without causing emission of electrons therefrom and said radiation source causes emission of electrons from said photocathode for flooding said control screen; and means for accelerating and collimating said electrons emitted by said photocathode.

7. In an image tube: an envelope; a photosensitive, electron permeable control screen positioned in said envelope; one end of said envelope being arranged for projection of a radiation image having a first wavelength region therethrough onto said control screen; a layer of photoemissive material deposited on the inner surface of said one end of said envelope to form a photocathode; and a source of radiation having a second wavelength region removed from said first wavelength region; said radiation source being arranged to illuminate said photocathode; said photocathode being sensitive to said second wavelength region and insensitive to said first wavelength region whereby said radiation image passes through said photocathode onto said control screen without causing emission of electrons therefrom and said radiation source

causes emission of electrons from said photocathode for flooding said control screen.

8. In an image tube: an envelope; a control screen positioned in said envelope and comprising a fine mesh metal screen with photoconductive material deposited on one side thereof; one end of said tube remote from said control screen and facing said photoconductive material being arranged for projection of a radiation image having a first wavelength region therethrough on said control screen; a photoemissive cathode disposed in said envelope at said one end and spaced from said control screen; and a source of radiation having a second wavelength region removed from said first wavelength region; said radiation source being arranged to illuminate said photocathode; said photocathode being sensitive to said second wavelength region and insensitive to said first wavelength region whereby said radiation image passes through said photocathode onto said control screen without causing emission of electrons therefrom and said radiation source causes emission of electrons from said photocathode for flooding said control screen.

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