NASA TECH BRIEF
Goddard Space Flight Center

A Magnetically Focused Image Tube Employing an Opaque Photocathode

The problem:

Optical images in infrared or ultraviolet spectra are beyond perception of the human eye. To see them, the observer normally uses an image converter that reproduces these spectra in visible light. This device converts ultraviolet and infrared optical images into electron beams which are projected on special screens making them visible. Unfortunately, existing image converters utilize relatively inefficient semi-transparent photocathodes. These converters are difficult to manufacture and their performance varies greatly from unit to unit.

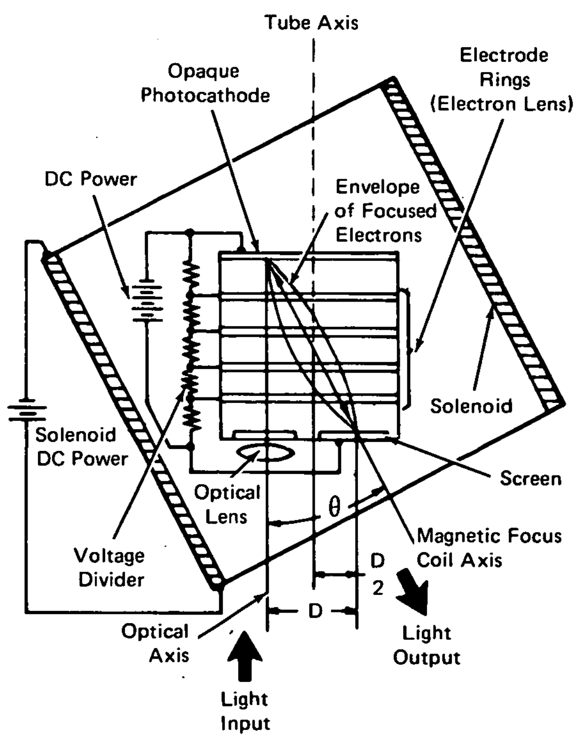

Image Converter

The solution:

An image converter has been developed which uses an opaque photocathode for improved efficiency. The device is easier to fabricate than the previous semi-transparent photocathode converters and uses compounds from Groups III-V that are responsive to wavelengths between the ultraviolet (approximately 100 nm) and the near infrared region (approximately 1000 nm).

How it's done:

The image converter (see figure) is a vacuum tube which includes a flat, opaque photocathode electrode at one end and a flat electron target electrode (screen) at the other end. The screen may be a phosphor surface for a direct optical readout of the electron beam image derived from the photocathode, or a gain/storage electrode read out by an electron beam. Both the electrode and the screen are within the line of sight of each other. Their planar faces are laterally displaced relative to each other so that an optical image on the emitting face is not obstructed by the screen. In response to the optical image focused on its surface, the photocathode emits an electron beam. This beam is then focused by the electron lens onto the phosphor screen.

The electron lens establishes a constant, dc, homogeneous electric field having a longitudinal vector along and parallel to the optical axis. It also provides a constant, dc, homogeneous magnetic field having a longitudinal vector between the photocathode and screen along and parallel to the magnetic focus coil axis. The magnetic coil axis is tilted at an angle θ from the optical axis.

The constant, homogeneous electric field is established by several evenly spaced, parallel, annular, metal electrode rings on the inner circumferential wall of the tube. The dc power supply whose negative and positive terminals are, respectively, connected to the photoelectrode and the screen, also provides a different

(continued overleaf)

intermediate potential on each electrode ring at several points along the voltage divider. The voltage at each of these points is proportional to the distance of the particular electrode ring from the photocathode.

In operation, the image on the optical axis is focused by the optical lens onto the photocathode surface. The photocathode emits electrons that are accelerated by the homogeneous constant electric field and focused by the magnetic field produced by the solenoid along the tilted axis. The electrons are uniformly accelerated along the tilted axis by the combined actions of the homogeneous, constant, electric and magnetic fields. The magnetic field also imparts cyclotron motion to focus the electrons on the screen. When the electrons strike the phosphor screen, they produce a visible image.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Code 207.1
Greenbelt, Maryland 20771
Reference: B73-10255

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
Goddard Space Flight Center
Code 204
Greenbelt, Maryland 20771

Source: C. Bruce Johnson and
Kenneth L. Hallam of
Bendix Corp.
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