NASA TECH BRIEF
Marshall Space Flight Center

Hologram Recording Tubes

The problem:

Optical memories allow extremely large numbers of bits to be stored and recalled in a matter of microseconds. Since the most promising method of transferring optical information is through a laser hologram, storage devices must not degrade under repeated hologram read/write cycles.

The solution:

Two new recording tubes have been developed. They are similar to conventional image-converting tubes, but have a soft-glass surface on which the hologram is recorded.

How it's done:

The tube shown in Figure 1 includes a thin photocathode, several rings that maintain a uniform potential distribution in the tube, and an anode. The hologram is recorded on the specially constructed anode.

A relatively thick glass plate with a high melting point serves as the anode substrate. A layer of soft glass (for instance, an arsenic trisulfide chalcogenide) is deposited on this plate. This layer is several microns thick and has a melting point around 180° C. A 300-Å layer of aluminum or gold, vacuum evaporated on the surface of the soft glass, serves as the actual anode.

The tube operates as follows: The laser object and reference beams are focused on the photocathode at their maximum intensities. A square-millimeter area is illuminated and emits electrons which are accelerated to the anode. This electron bombardment softens the anode glass and deposits an electric charge on its surface. Next, the laser intensity is greatly reduced. During this period, a small additional charge is trapped in the soft-glass layer in a distribution pattern dependent upon the hologram. These charges produce forces that deform the

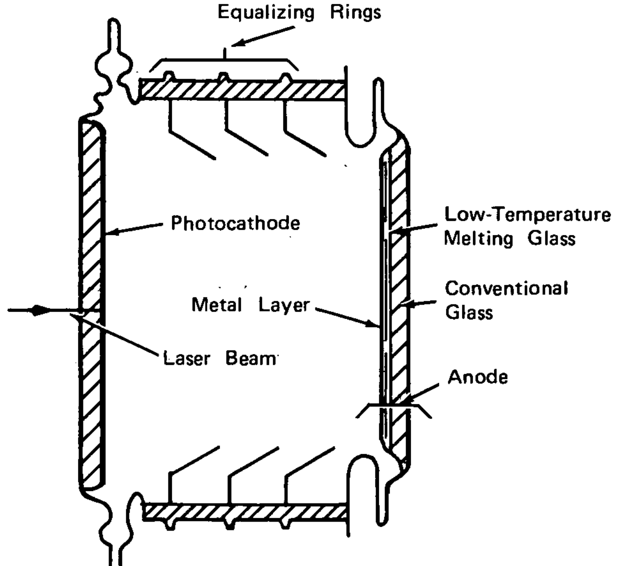

Figure 1. Vitreous Recording Tube

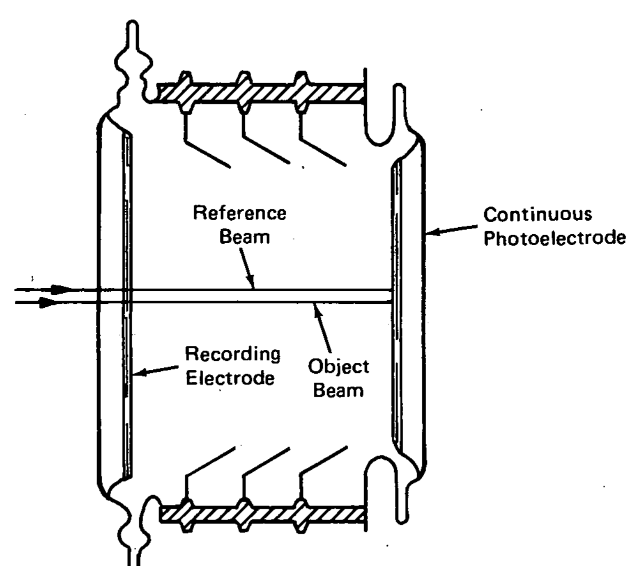

Figure 2. Two-Photoelectrode Recording Tube

(continued overleaf)

glass, which cools in its new shape. The image is read by directing a low-intensity reference beam on the deformed anode glass and is erased by a high-intensity beam.

In the second tube (Figure 2), the soft-glass recording surface is placed over a thin photoemissive layer. A metallic layer is deposited, on top of the soft glass as a myriad of islands about 1000 Å across.

Here, the hologram beam is directed through the recording-surface electrode first. In the first step a high-intensity beam passes through the recording electrode and strikes the other continuous photoemissive surface. This surface is pulsed to be negative in reference to the grounded recording electrode. The result is a stream of electrons which return to the recording electrode along the beam path and soften and charge the glass.

Next, the continuous photoemissive electrode is made positive, a lower intensity beam is pulsed, and the emitted electrons are attracted from the recording electrode, leaving a charge distribution representative of the hologram. When the glass cools, it can be read or erased by the reference beam.

Notes:

Requests for further information may be directed to:

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Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457 (f)] to RCA Corp., Princeton, New Jersey 08540.

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