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NASA TECH BRIEF

Lyndon B. Johnson Space Center

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Wide-Field Reflective Scanning Optical Systems

The problem:

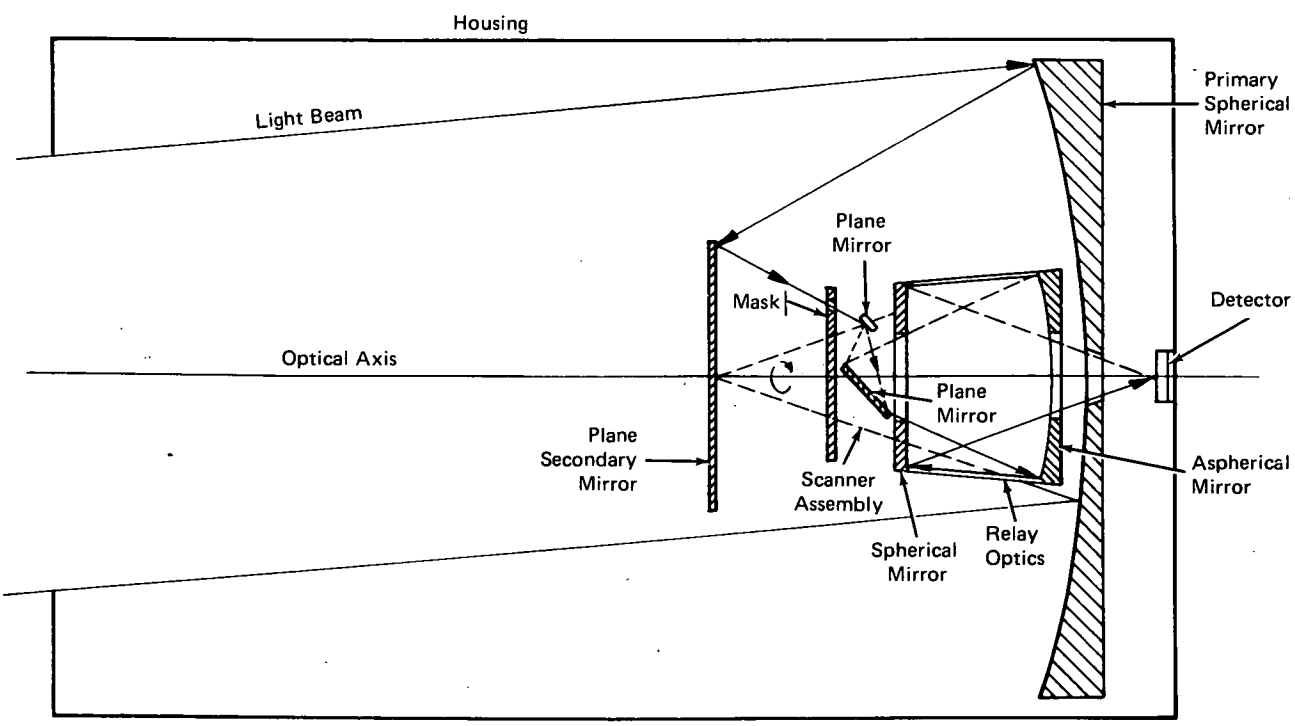
Purely reflective (catoptric), scanning optical systems are an important component in scanning radiometers and spectroradiometers. Used in earth-resource surveillance satellites, these scanning systems must provide a relatively fast line-scan rate for a two-dimensional coverage of the Earth's surface below. Rapid scan rates in optical scanning systems, in general, require low focal ratios between components and the smallest possible masses. In addition, the systems must be relatively free from monochromatic defects and chromatic aberrations, and any obscuration must be independent of the scan angle.

The solution:

A catoptric optical scanning system was developed which satisfies the above requirements.

How it's done:

The system, as shown in the figure, comprises a set of mirrors arranged in a specific configuration and enclosed in a housing. The scanner assembly comprises a pair of plane mirrors mounted for unitary rotation about an optical axis. The larger of the two mirrors intersects the optical axis at an acute angle. Both mirrors are normal to a common plane containing an optical axis and form opposite faces of a rhomboidal polyhedron. Upon



Scanning Optical System

(continued overleaf)

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rotation, the smaller mirror traces a section of conical surface coaxial with the optical axis.

Light from the object being observed is reflected from a primary spherical mirror onto a plane secondary mirror. The secondary mirror reflects this light through an arcuate mask to the scanning assembly. The scanning assembly in turn reflects this light onto the relay optics. Light enters the relay optics and is reflected first by an aspherical mirror and then by a spherical mirror to focus on a detector. The two spherical mirrors and the aspherical mirror have central apertures to permit the passage of light.

As the scanner assembly rotates about the optical axis, the line of sight of the instrument traces an arcuate linear sweep. Light enters the instrument in such a direction that its major component is aligned with the optical axis. It emerges from the scanning assembly as a diverging axial field. Thus, the only correction necessary for the spherical aberration is provided by the aspherical mirror.

The system has the following features:

1. Only reflective elements are used to cover a broad spectral region.
2. The image plane scanning allows a high scan rate (about 6000 rpm).
3. Rotational scanning is used rather than oscillatory scanning to produce this high scan rate.
4. A very large scan angle permits the coverage of a large area.
5. The system has a relatively simple configuration.
6. Two small mirrors are the only movable optical elements.

Note:

Requests for further information may be directed to:

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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:

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