NASA TECH BRIEF

Improved Optical Lens System

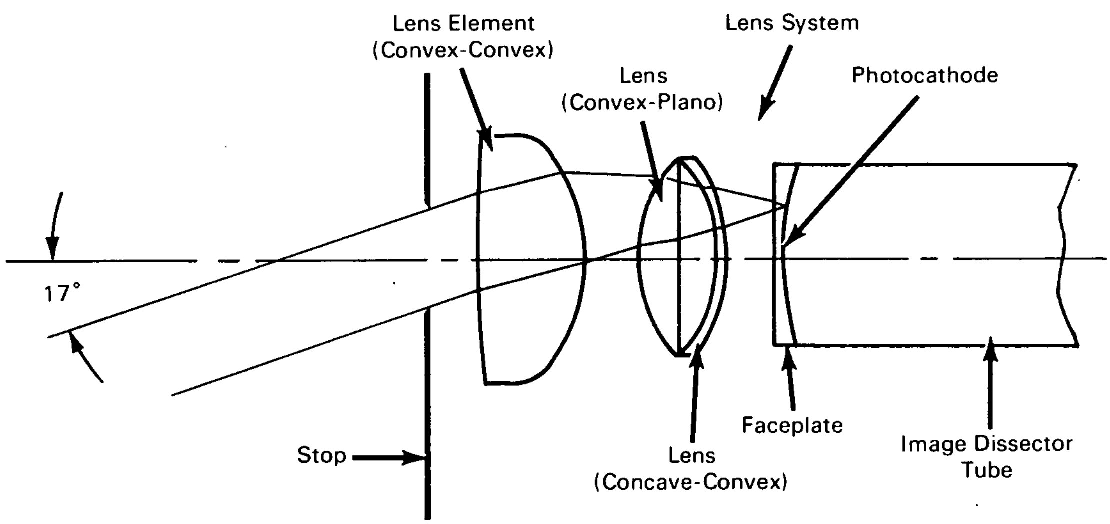

Figure 1. Lens System

A computer-program-aided design of a lens system for tracking stars resulted in an objective lens capable of producing a backwardly curving image of the star field that matches the similarly curved surface of the photocathode of an image dissector tube. With this lens, the previous requirement for a fiber-optics translation between the flat plane image produced by the optics and the curved photocathode was eliminated. The improvement enhanced resolution and reliability and effected substantial savings in direct and peripheral costs. This lens system should be of interest to astronomers and to the optical industry. The design principles of the lens system may also be applied to television image orthicon tube systems.

Startrackers utilized an image dissector tube for sensing the relative angular position of a star. Their purpose was to develop a signal for controlling rotation of the spacecraft about the roll axis during the mission. The image dissector tube conventionally has a backwardly curving, spherically shaped photocathode upon which the star field is imaged. Because it had not been practicable previously to design a lens system that would produce a star field image matching this curvature, special image dissector tubes were employed in which a fiber-optics transmission medium was incorporated in the faceplate to effect the necessary translation in planes.

The new lens system and its design are illustrated in Figure 1. A stop is positioned between the star field and the first element, the convex-convex lens. This stop, used in conjunction with the lens system and the two-stage baffle arrangement, has helped to overcome stray light. This position of the stop minimizes the physical size of the stray-light baffle, which

(continued overleaf)

still has a volume greater than the rest of the tracker. The second element in the system is a convex-plano lens, and the third element is a concave-convex lens. The faceplate of the image dissector has a plano-concave configuration; its concave surface is the photocathode upon which the star field is imaged.

Figure 2 shows the lenses in suitable housing, with provision of porting holes and grooves for outgassing during evacuation tests. This new design produces a true, backwardly curved image of the star field. The entrance lens is fabricated from fused silica that provides some radiation protection for the other lens elements. The lenses are treated with the usual antireflection coating prior to assembly.

Notes:

1. Computer programs used with this lens system were reported in TR-67-700-10-2, Volumes 1, 2 and 3, "Fortran Optical Lens Design Program" by P. J. Firnett and L. A. Wilson.
2. This lens and detector system could be applied in spectrophotometry, sophisticated light source systems, and opto-electronic systems which require precise image formation.
3. Requests for further information may be directed to:

   Technology Utilization Officer
   NASA Pasadena Office
   4800 Oak Grove Drive
   Pasadena, California 91103
   Reference: TSP70-10354

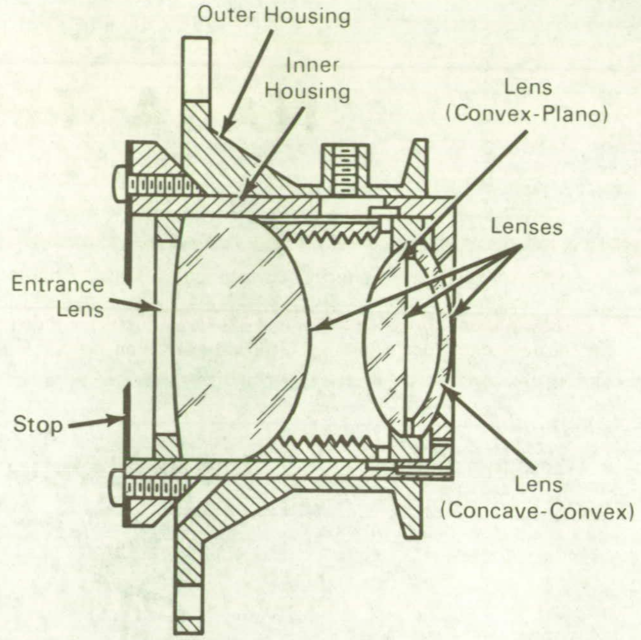

Figure 2. Lenses and Housing

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: L. F. Schmidt of Caltech/JPL under contract to NASA Pasadena Office (NPO-11311)