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NASA TECH BRIEF

Star/Horizon Simulator Used to Test Space Guidance System

A star/horizon simulator, basically a refractive collimator with a 2-inch objective lens system and a 24-inch focal length, capable of simulating stars and the earth's horizon, is described. The unit is used for alignment and optical plus photoelectric tests of the Apollo guidance and navigation system Optical Unit Assembly (OUA). The OUA consists of a scanning telescope and sextant, however, since the simulator is used only for testing the sextant, the scanning telescope is not discussed here.

The sextant consists of a fixed visual line of sight (fixed with respect to the OUA), an articulating visual line of sight, a fixed photosensitive line of sight, and an articulating photosensitive line of sight. The sextant is used during the Apollo mission for angular measurements between stars, stars and landmarks, and stars and the earth's horizon in a manner similar to the use of a navigational sextant on seagoing vessels.

The star/horizon simulator lens system, consisting of a doublet lens, transmits electromagnetic energy in the 3000 to 8000 Å range and is color corrected for focusing at 3500 Å and 5760 Å. The collimator is focused at infinity and can project circles of 5 arc seconds, 30 arc seconds, and 30 arc minutes. The 5 and 30 arc second circles are used to simulate stars while the 30 arc minute circle is used to simulate the earth's horizon. The 30 arc minute horizon is formed by projecting condensed diffused light through a circular aperture and reflecting it from a front-silvered mirror located at the focal point of the collimator. The 5 and 30 arc second stars are etched on the same front-silvered mirror and are formed by projecting condensed diffused light from the rear of the mirror through the etched areas. Spectral content of the stars and horizon is matched to the sextant photosensor range by suitable filters. Super micrometers (accurate to 0.000050 inch) permit limited, calibrated movement of the stars in two directions mutually perpendicular to the optical axis.

To gain collimated light greater than the 2-inch aperture would normally exhibit, two mirror array assemblies provide lines of sight separated by approximately 6 inches, or the equivalent performance of an 8-inch collimator. Each mirror array assembly consists of two front-silvered mirrors set at a discrete distance apart and with reflective surfaces parallel within 3 arc seconds. One mirror in each assembly is pierced with a circular aperture to allow a portion of a light beam directed at that mirror to pass through it to the second mirror. The mirror reflective surfaces are set at 45° with respect to the collimator axis and the original 2-inch collimated bundle is divided at the first mirror (part reflected and part passing through the aperture to the second mirror) and two collimated beams obtained. Parallelism of the mirror array assemblies is checked by standard autocollimation technique. Absolute calibration of star magnitude and horizon intensity is accomplished by comparison of the star/horizon simulator output with the output of a luminescent radioactive substance.

Notes:

1. Incorporation of the two mirror array assemblies to obtain the effect of an 8-inch collimator from a 2-inch aperture should have definite application in other optical areas.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center
   Houston, Texas 77058
   Reference: B67-10110

(continued overleaf)

Patent status:

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

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