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NASA TECH BRIEF

Goddard Space Flight Center

Fine Guidance for a Spaceborne Telescope

The problem:

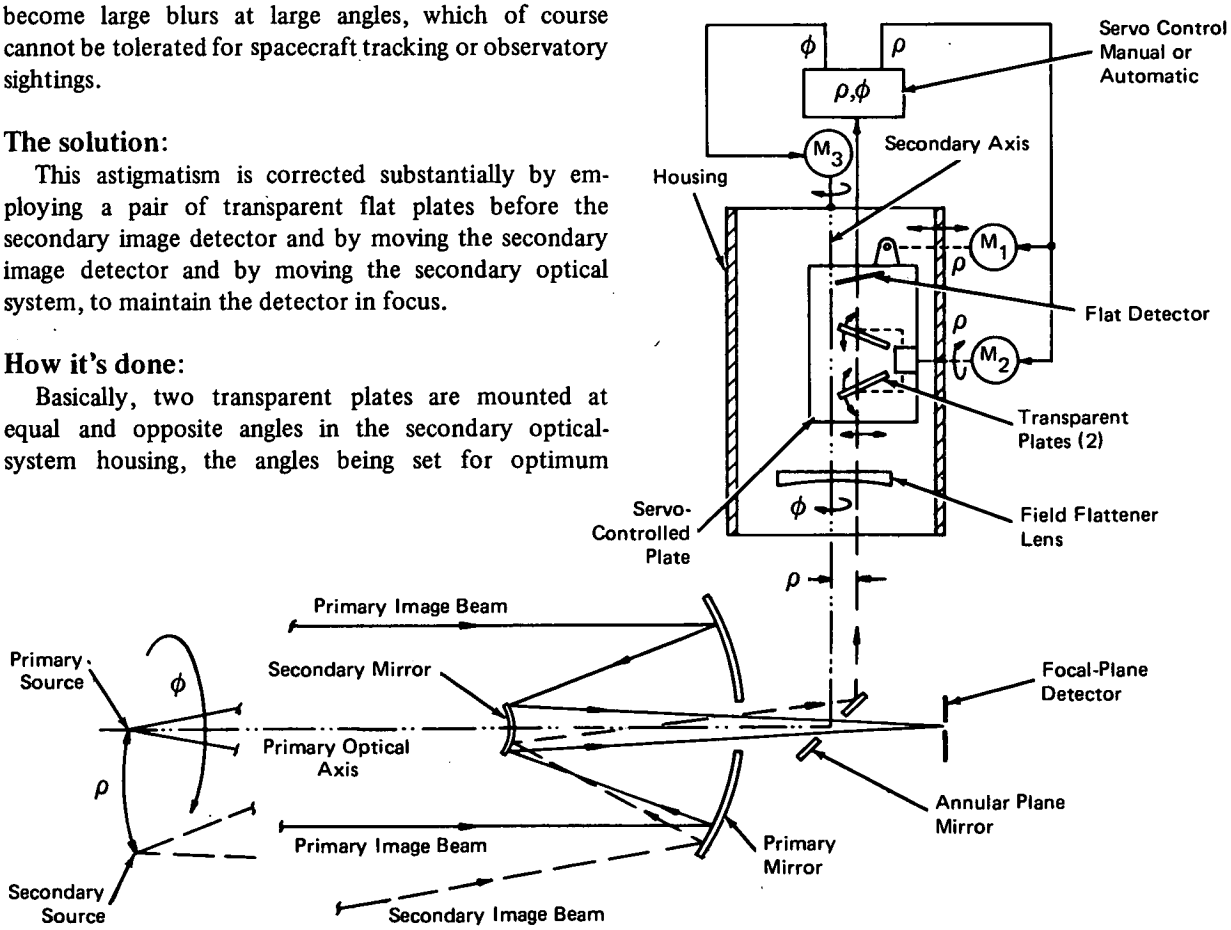
Ritchey-Chretien telescopes are designed for the simultaneous observation of two optical images, one of which is located on the primary axis and the second off-axis. The problem with these telescopes involves an increasing astigmatism as the off-axis angle of the secondary image increases. Secondary images, as a result, become large blurs at large angles, which of course cannot be tolerated for spacecraft tracking or observatory sightings.

The solution:

This astigmatism is corrected substantially by employing a pair of transparent flat plates before the secondary image detector and by moving the secondary image detector and by moving the secondary optical system, to maintain the detector in focus.

How it's done:

Basically, two transparent plates are mounted at equal and opposite angles in the secondary optical-system housing, the angles being set for optimum astigmatism correction. The rotation of the secondary housing assembly and the translation of the detector are proportional to the angular position of the secondary image. The combined movement of the two retains the image within the sagittal (secondary) foci of the secondary system.



Ritchey-Chretien Telescope

(continued overleaf)

The telescope as shown in the figure is divided into two systems. The first system is responsive to optical energy from an on-axis (primary) source, and the second is responsive to the off-axis (secondary) source. Both systems obtain their images from the primary and secondary hyperbolic mirrors that are centered about the primary optical axis. The primary optical system includes a focal-plane detector for monitoring the primary on-axis source.

The secondary optical system is centered about the secondary optical axis. This axis is orthogonal to the primary axis, as projected through the center of an annular-plane mirror. Light from the secondary image is reflected from this mirror and is transmitted through a field-flattener lens to the two transparent flat plates. Each of these plates is identical in thickness and has the same index of refraction. Light transmitted through these plates is directed to a flat detector.

Both the detector and the plates are mounted on a servo-controlled plate. This plate is translated horizontally with servo M_1 and is rotated by M_2 about the axis that is perpendicular to the secondary optical axis. The extent of the translation and rotation is directly proportional to the field angle, ρ, i.e., the field angle formed between the primary optical axis and the secondary image. In addition, servo M_3 rotates the entire secondary system housing by an angle ϕ, which is the angular position of the secondary image on the plane perpendicular to the primary axis. All three servos can be controlled either manually or automatically.

The combined motion of all of these components maintains the position of the secondary image detector on the sagittal (secondary) foci of the telescope. The result is that the secondary image is maintained in focus at all times, with the astigmatism being corrected by the two transparent plates.

Note:

Requests for further information may be directed to:

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Reference: TSP73-10468

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,752,559); Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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Source: Seymour Rosin and
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