AEC-NASA TECH BRIEF

Determination of the Absolute Contours of Optical Flats

The problem:

Development of a procedure for determination of the true absolute contours of optical flats. Other techniques entail the scanning of coated plates, the examination frequently utilizing different parts of the auxiliary optical system; aberrations in the optical system and the coating itself then introduce optical errors. Emerson's procedure (the one in use at the National Bureau of Standards) avoids these problems, but mapping of a whole plate by this procedure is laborious, and higher precision may be desired. A more precise method would permit reliable examination toward the end of the figuring process and would decrease the labor in determination of a standard flat.

The solution:

Emerson's procedure for determination of the absolute contours of highly precise optical flats was preferred for its greater precision and for the speed with which readings were taken. The precision achieved in determination of a set of differences between two plates was approximately 1/600 of a Fizeau fringe; in determination of the absolute contour, 0.005 of a Fizeau fringe (estimated). The fringes were scanned over a photoelectric detector and the intensity profile was presented on an oscilloscope. Setting was accurate within a fraction of 100th of a fringe. A complete set of data was gathered on a data logger in about 5 minutes.

How it's done:

By Emerson's method the absolute contours of the standard flats are determined by intercomparison of three sets of flats and solution of the three sets of differences to yield the absolute contour of each flat. Comparisons are then made between the standard flats and unknown flats whose contours are calculated from the differences and the known contour of the standard flat. The contour differences are determined by measurement of the deviation of a Fizeau fringe from straightness when the plates are transported parallel to the fringe system under a Fizeau-fringe viewer; the position of the flat, the spacing of the fringes, and the deviation of the fringe from straightness must all be measured. The fringe position is read visually by setting of a cross hair on the fringe.

In this new method the plates are transported perpendicular to the fringe systems, and only one set of readings is required—the fringe positions; and, for increased speed of reading, the positions are recorded on an automatic data logger.

In order to increase the precision of setting on the fringes, a photoelectric procedure is adapted for reading of the fringes. The image of the fringe is swept across a slit in front of a photoelectric cell, and a signal, proportional to the light intensity, is placed on the vertical plates of an oscilloscope. The same sweeping device is used to develop an increasing and a decreasing ramp alternately on the horizontal plates of the oscilloscope. Thus two representations of the light intensity of the fringe pattern are formed: one plotted from left to right; the other, from right to left. When the fringe is centered on the slit, the two patterns are superimposed. The slit is thus the fiduciary mark for the fringe position. In principle the precision can be controlled over many orders of magnitude by alteration of the amplification at the oscilloscope, but in practice the mechanical stability of the sweep system and electrical noise in the photoelectric system and the light source limit the precision.

(continued overleaf)

Notes:

1. For details see W. Primak, *Appl. Optics* **6**(11), 1917 (Nov. 1967).
2. This information may interest the optical industry, particularly manufacturers of optical flats for interferometers.
3. Inquiries may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B69-10209

Source: William Primak
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Patent status:

Inquiries concerning rights for commercial use of this innovation may be made to:

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