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NASA TECH BRIEF

Laser Interferometer Micrometer System

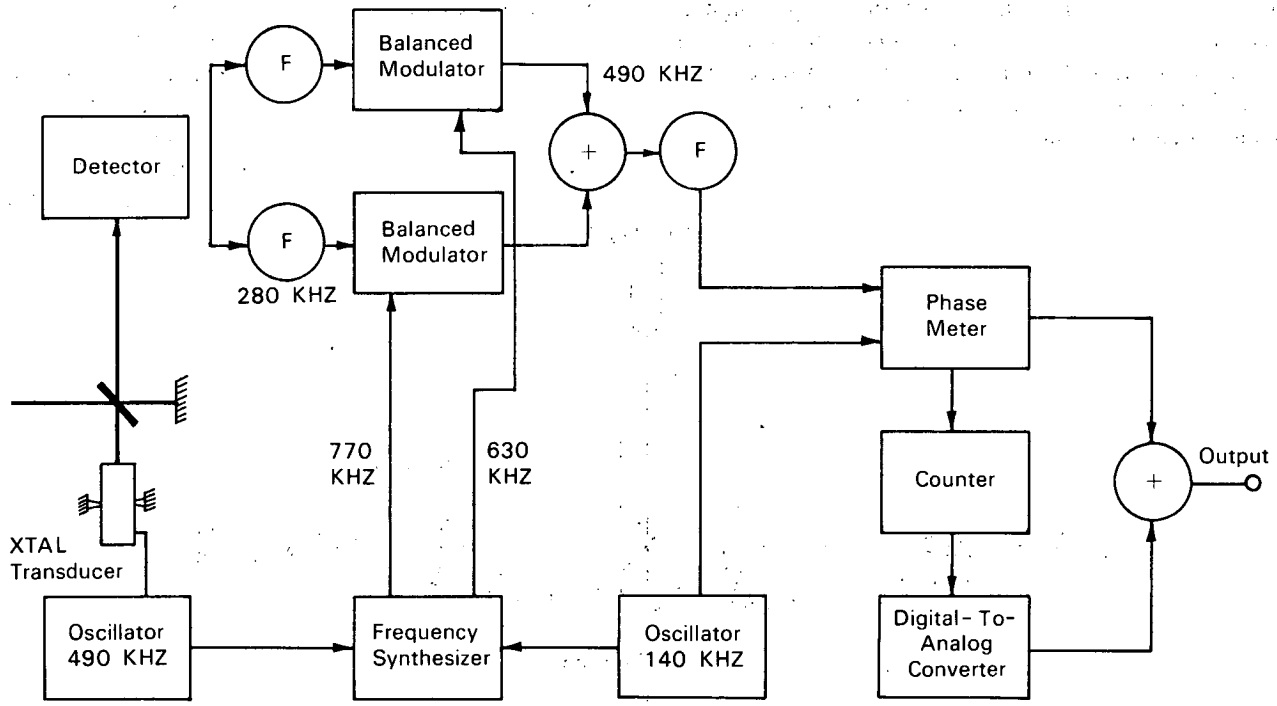

Figure 1. Light Phase Converter

A Laser Interferometer Micrometer System has been developed that measures dimensions to microinch accuracies. The system uses light beams, a technique that eliminates the errors inherent in other systems that are due to deformations and surface irregularities. Although the system is designed to measure precision gyro and gas bearing parts it obviously has many other applications in measurements requiring extreme accuracy.

The system uses three interferometers: two are mounted on mobile platforms to view the measured object and a third measures the dimensional changes between the mobile platforms. The red laser light provides wavelength precision while white light is used to specify one of the red fringes as the zero distance.

This micrometer system employs the principle of measuring light phase changes rather than a direct fringe count. This method reduces ambiguity and results in a more accurate resolution. A digital counter provides the capability of measuring larger dimensions.

The two figures illustrate the principle of operation of the system. The laser light source emits a narrow beam which is divided into two components

(continued overleaf)

by the interferometer beam splitter. The resulting fringe pattern signal varies sinusoidally as the path length changes when the light intensity variation is converted by a photomultiplier. This signal is phase-modulated by the vibrating transducer; this signal is then applied to the 140 kHz reference signal generated by the 140-kHz oscillator. The outputs of the detector, the 140-kHz reference signal plus the doubled signal of 280 kHz are coupled to balanced modulators where the two signals are used to subtract from two other input signals of 630 kHz and 770 kHz. The resulting output of 490 kHz is connected to a phase meter which produces an analog of the phase modulation in the form of an output voltage.

In the system operation, the outputs of the two interferometers on the mobile platforms are coupled to the phase meter with one of the output signals functioning as the reference. The interferometer measurement thus becomes the sum or difference of both interferometers, the sum or difference function being switch-selectable.

Notes:

1. This instrument must be used under controlled laboratory conditions where temperature can be controlled and clean room conditions prevail.
2. Applications of this instrument are indicated where small linear dimensions must be measured with extreme accuracy. Examples of such application are for gyro-testing devices, strain gages, film-thickness gages and vibration monitors.
3. Requests for further information may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center, Code BM7
   Houston, Texas 77058
   Reference: TSP-10633

Patent status:

No patent action is contemplated by NASA.

Source: S. H. Logue of
General Dynamics,
Convair Division,
under contract to
Manned Spacecraft Center
(MFS-14747)

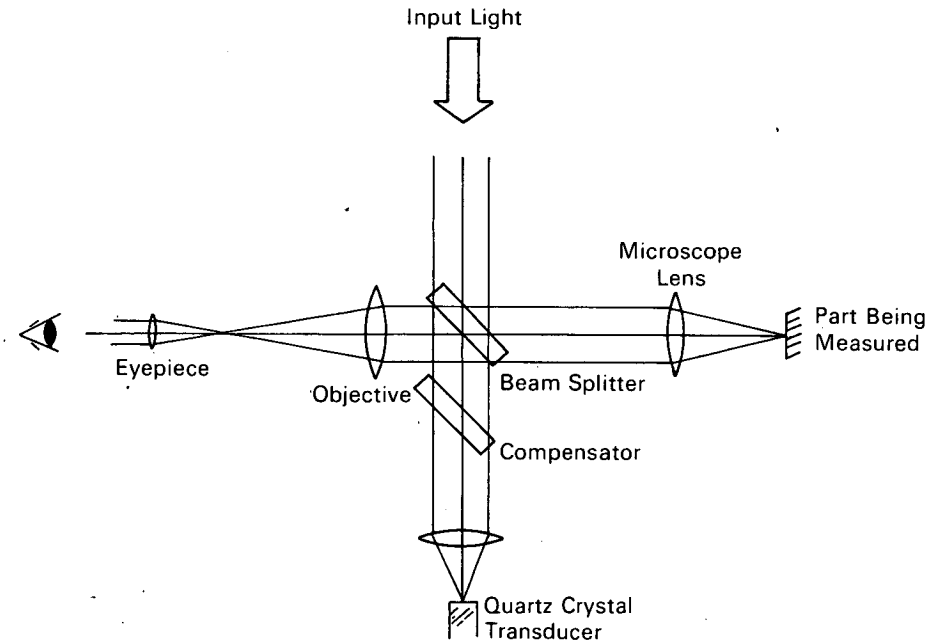

Figure 2. Basic Interferometer