The only settings required of the operator is a zero reset button and a magnitude of accuracy setting knob determining the operating range. STAT

The [redacted] DIGITIZER contains three units, as shown in Figure 1, Linear Measurement. The measuring interferometer with its precision optical components produces optical fringes developed by an internal light source. Counting a number of fringes determines distance traveled. The wavelength used is produced by a Hg-198 light source with a filtered frequency of 5461 Angstroms. STAT

The stability of measurement with the [redacted] DIGITIZER is assured by unique method of mounting the optics that do not require adjustment after extended usage. A split phase, three photomultiplier detection gives highly accurate reversible sensing of fringes, independent of reasonable variation of input voltage, environmental conditions, and time of operation. STAT

For operation, the sensor is normally stationary mounted. The travelling tetrahedral prism is mounted on the moving body whose location it is desired to determine. As the body moves, light wave fringes are formed and are counted, between the tetrahedral prism and the sensor representing its exact displacement to a repeatable accuracy.

Controls and Counter:

Automatic optical fringe counting is achieved by a novel (patent applied for) detection scheme using three photomultipliers. The combination of optics and electronics assures that accurate measurements are obtained independent of vibrations or overshoot of the measured table. A numerical unambiguous output is developed in a visible counter display.

The counter can be provided with a standard accessory of 4 line BCD readout for use for automatic readout, on punch tape, punch card or magnetic tape. A manual preset counter as an accessory will allow the operation of the [redacted] DIGITIZER in a closed loop servo. Accessory digital circuits are available for operation of the automatic control from a storage medium such as a Flexowriter or magnetic tape or drum.

The control box and counter are made of several plug-in packages and interchangeable circuit boards, tested for stability and reliability.

The [redacted] DIGITIZER is universal system developed to measure either distance or angles. Angular rates or linear rates over time may also be measured to an unprecedented accuracy. The same controls and counter are utilized, the only difference being the optical configuration of the interferometer.

STAT

Automatic Linear Interferometer:

Figure 1 illustrates the general configuration for linear STAT measurement [redacted] Each count on the digitizer can be selected to measure in either of the following:

1. 0.273 microns or 10.8 millionths of an inch.
2. 0.136 microns or 5.4 millionths of an inch.
3. 0.068 microns or 2.7 millionths of an inch.
4. 0.023 micron or 0.9 of one millionth of an inch.

Three models are provided with successive increase in cost:

1. Total Range ± 1".
2. Total Range ± 5".
3. Total Range 1 meter (Special Type).

A major feature of the [redacted] DIGITIZER is its inherent STAT ability to measure the distance between two points to an unprecedented accuracy independent of the accuracy of the guide ways of the measured member providing they are vibration free. Thus, ± .001 in. out of straightness can be tolerated in the Y and Z axes providing that the stability of the ways is established. Skewing errors of a few minutes of arc can also be tolerated.

STAT

To enhance the use of the [redacted] DIGITIZER [redacted] STAT has developed patented mechanical ways adaptable to linear measuring tables and various types of test equipment.

STAT

STAT [redacted] DIGITIZER for Angular Measurement:

Figure 2 illustrates the general configuration for angular measurement [redacted] Each count on the digitizer will measure angles to an accuracy of .05 second of arc for a range of 1°. STAT

With the application of a timing device the Model [redacted] will measure angular rate to an accuracy of .05 second. STAT

This instrument measures the relative angular orientation of a table or other devices such as gyros or stabilized platform guidance systems. The sensing package is located to observe two returning light beams generated by a light source within the interferometer. An optical block containing two tetrahedral prisms is mounted on the table or object being calibrated. Consequently, as the table rotates, one return optical path is decreased or increased relative to the other, allowing the fringes to change. The generated angle is measured by the number of wavelengths of light that constitute the difference of path lengths. The exact angle to an accuracy of .05 second of arc is read on the Digitizer due to the inherent stability of light wave measurement.

STAT [redacted] DIGITIZER for Angular measurement are available in the following standard packages: STAT

1.0 second per division.

0.5 second per division.

0.2 second per division.

0.1 second per division.

0.05 second per division.

0.02 second per division (on special order).

A range of measurement up to 5° is obtained. The linear distance between the rotating member and the sensor can be as small as 0.2" or larger than one meter. CONSEQUENTLY, THE [redacted] Digitizer WILL REPLACE AUTOCOLLIMATORS WITH A CONSIDERABLE INCREASE OF ACCURACY AND RANGE. STAT

<u>Angular Rate Automatic Interferometer</u>:

STAT Angular [redacted] DIGITIZER [redacted] will measure angular rate. The accessory is a precision electronic oscillator as a time standard. The counter measures the total angular motion per unit time. It can be adjusted from a fraction of a second to few minutes of time. The counter displays the total angular motion within preselected unit of time. The accuracy of the time interval is one part in 10^{-6}, while the accuracy of the [redacted] DIGITIZER is better than .05 second of arc. STAT

Angular Generator: STAT

STAT [redacted] DIGITIZER with Micro-Positioner, Figure 3, shows this angle generator containing the time-proven STAT [redacted] Micro-Positioner. Angles are measured as described STAT above under [redacted] DIGITIZER for angular measurement. The Micro-Positioner contains a mirror or a porro prism rotating about a vertical axis manually or automatically. The angular deviations of the mirror or porro prism is measured by the standard angular STAT [redacted] DIGITIZER.

The standard system provides manual angular rotation with a total range of ±6.7 minutes of arc, and accuracy of 0.05 second over the full range. Accessories are available for control of the angular generator from a remote preset counter, or from punched tape. Extended ranges up to 5° are available.

Size and Weight:

Measuring Interferometer: 12" x 8-3/4" x 5-3/4" high.

Controls and Counter:

Standard Rack: 12" high x 19" wide x 15" deep - 45 pounds.

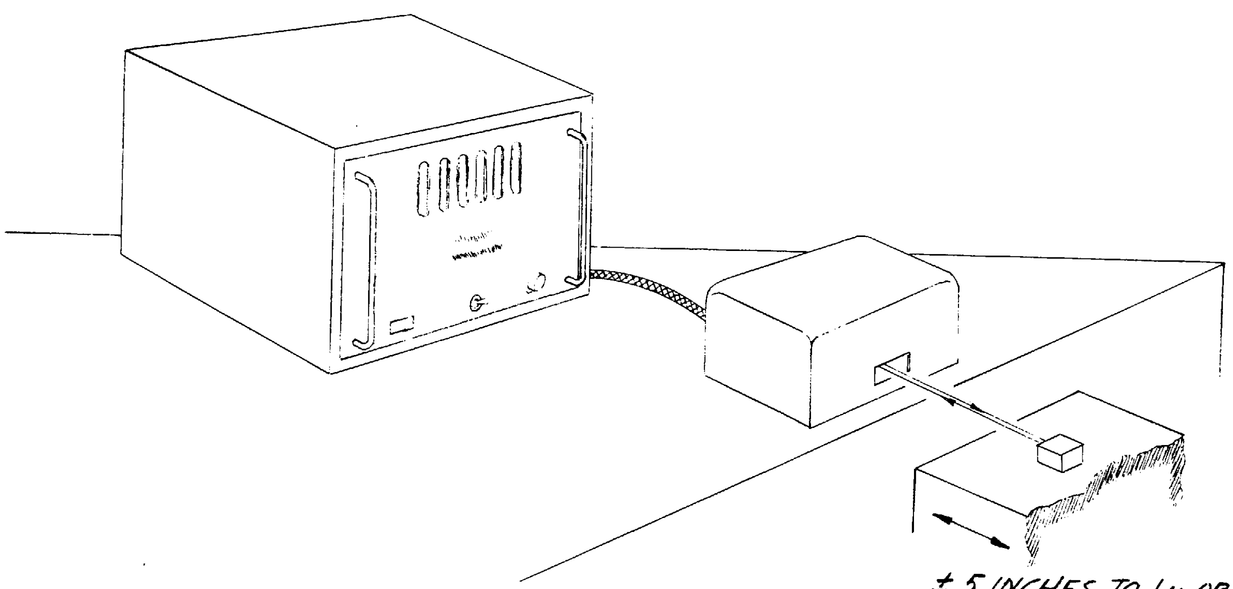
Cabinet: 14½" high x 18" wide x 18" deep - 75 pounds.

Power requirement: 115 volts - 60 cps - 2 amperes.

STAT

This exciting development opens the door to new concepts of measurement of an unprecedented accuracy of angular and linear measurement.

Your inquiries for its applications to your problems are invited. There is an application of this device to every phase of industry from Optics - Metrology - Chemistry - Electronics.



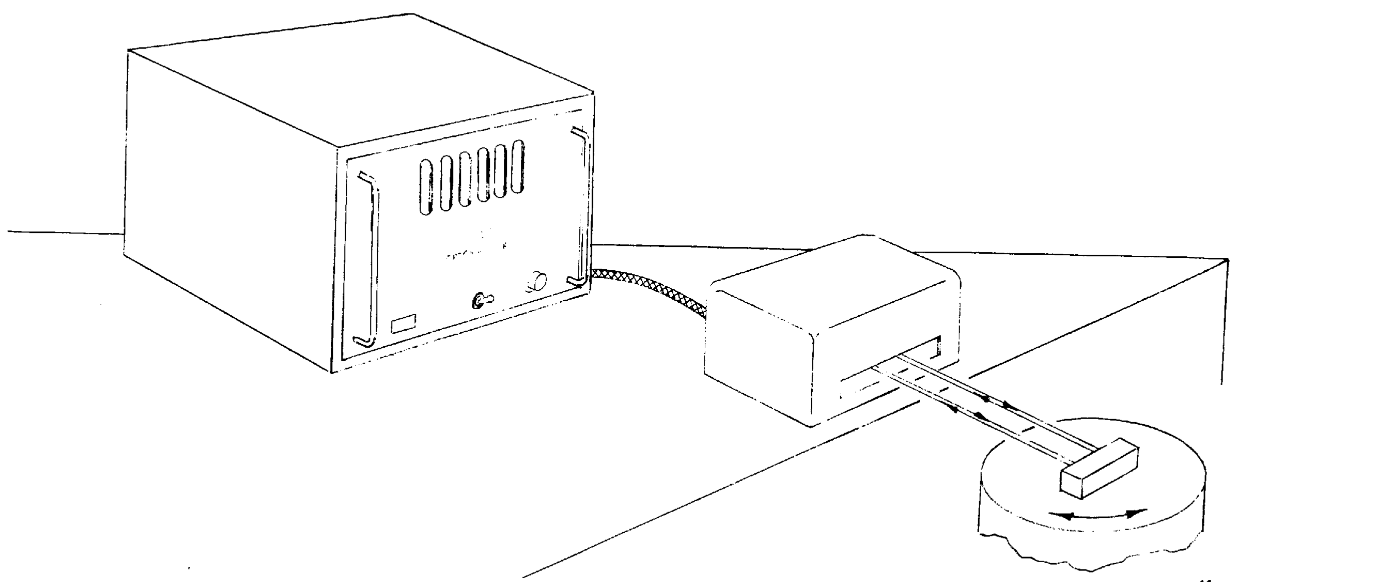
STAT [redacted] DIGITIZER

STAT [redacted]

LINEAR MEASUREMENT

FIG. 1

STAT [redacted]

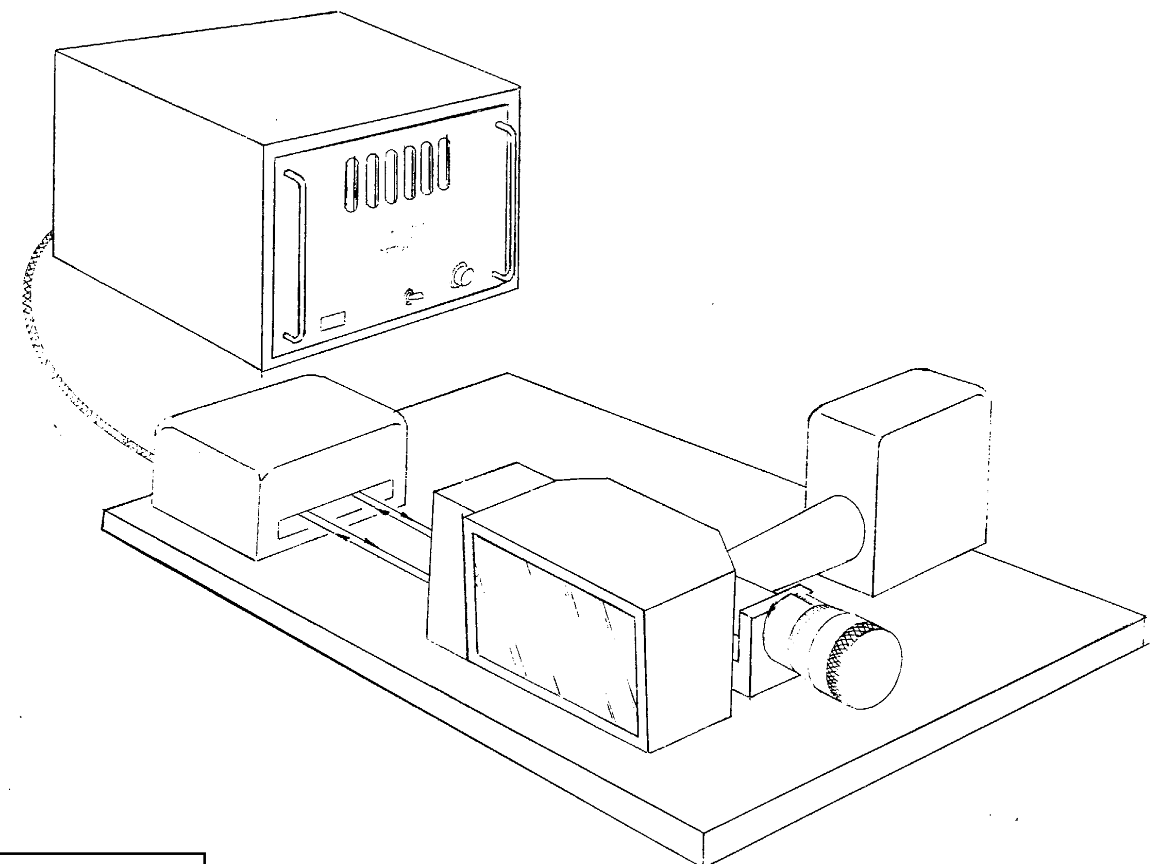


STAT [redacted] DIGITIZER

STAT [redacted]

ANGULAR MEASUREMENT

FIG. 2



STAT [redacted] DIGITIZER [redacted]
STAT
WITH
ANGLE GENERATOR MICROPOSITIONER [redacted] STAT

FIG. 3

 [redacted] STAT

LINEAR INTERFEROMETER

STAT

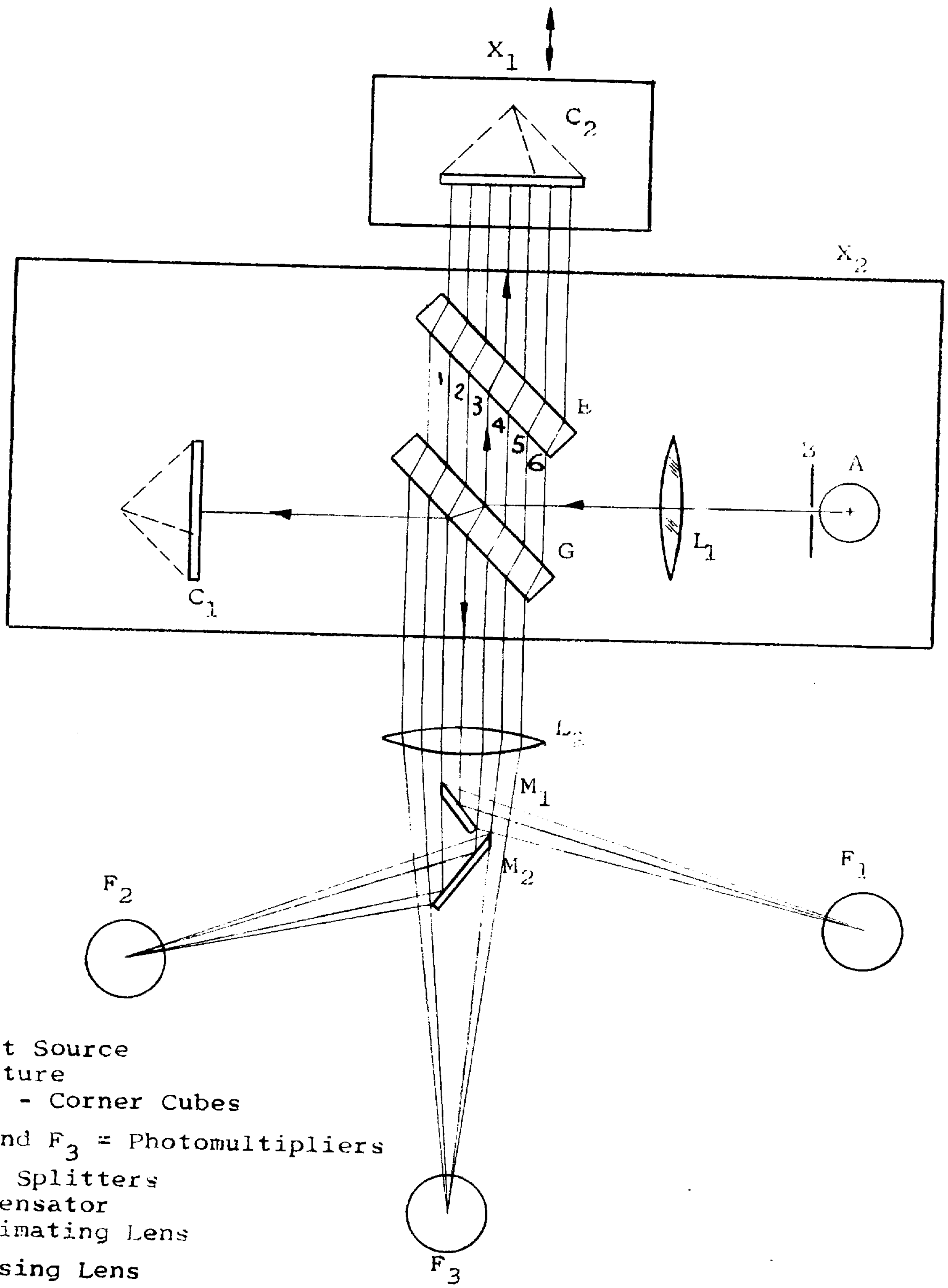
The optical arrangement of the linear interferometer is shown in Figure 1. A monochromatic light source ( ) is used with an aperture (B). The illumination is collimated by lens (L_1) and is directed onto the beam splitter (G). It is then separated in two parts: (I) to a tetrahedral prism C_1, which is then reflected back to G, at which a portion is reflected to the lens L_2; and (II) to the compensating plate E and then to a tetrahedral prism (C_2) back to E, G, and then to the lens L_2.

The interferometeric fringes are formed by the interaction of the light paths (I) and (II) such that the amplitude seen at (L_2) can be the summation of the illumination through (I) or (II) as a maximum, and their difference as a minimum. Thus, if one would move the tetrahedral prism C_2 at a constant speed, then the amplitude observed is approximately sinusoidal in nature. The illumination passed by the aperture (B) is then modulated by the relative motion of prism C_2 to C_1. This motion is not dependent on the angular orientation of C_1 or C_2, since the tetrahedral prisms return the beam parellel to itself independent of its angular orientation. In addition, the linear displacements in axis other than that in line with the light path introduce no errors as long as they are less than .002".

STAT

In this manner, the interferometer measures only linear distance in line with the light path, which is independent of other angular or linear displacements.

STAT



A = Light Source
B = Aperture
C_1 and C_2 - Corner Cubes
F_1, F_2, and F_3 = Photomultipliers
G = Beam Splitters
E = Compensator
L_1 = Collimating Lens
L_2 = Focusing Lens
X_1 = Corner Cube Mounting Block
X_2 = Interferometer Mount.
M_1, M_2 = Front Surface Mirrors.

Figure 1
Linear Interferometer.