By making use of the two sensors working in a differential system, an optimal linearity of the magnetic field representation can be reached, assuming, of course, that there are no other disturbing agents. In this case the instrument's characteristic transfer function coincides with the quasi-linear part of the sine curve in the vicinity of 45°. For the sine curve range of 30°—60° in the method of differential signal processing the nonlinearity should be less than 1 per cent, and this is being confirmed in practice.

In the actual construction of the instrument the signals from the photoelectric sensors (photodiode FK4 made by ITE) are preamplified in pre-amplifiers 13 and 14 built in as emitter duplicates operating in the Darlington's system, and then put into differential system 15 which operates on a symmetrical amplifying step with emitter coupling. A pair of complementary transistors NPN and PNP constitutes the output of amplifier 16 of the electronic system. The transistors operate in the B class as an emitter duplicate with output resistance of 150 Ω, coupled with oscilloscope 17 which operates in cooperation with photographic camera 18.

For the purpose of the precise scaling of the amplitude, the device is equipped with an additional Faraday's modulator 19 whose winding constitutes an element of sine-wave-form generator 20 with two frequencies: 200 Hz for recording waveforms with the time base less than 5 s, and 1 MHz for faster waveforms.

The designed instrument may serve for making measurements and oscillograms of current waveforms, of current surges of amplitude up to 100 kA and voltages up to 100 kV relative to earth, with the rise time not less than 50 nanoseconds.

The device has been designed and built for the Institute of Nuclear Research, for studying big currents and magnetic fields occuring in works connected with the plasma generation.

The optics of the instrument has been calculated in the COL Geometrical Optics Division. The high voltage and energetic side of the tests and measurements was covered in collaboration with the High Voltage Division of the Institute of Electrotechnology.

Jan Jasny *

Focal-Length Digital Meter

In the Polish Central Optical Laboratory a new method has been developed for measuring the focal-length of single lenses and complicated condensing systems. The method consists in comparing a fixed spatial frequency of a grating, placed in the focal plane of the measured lens, with changing spatial frequency of a set of moiré fringes. The principle of measurement is shown in Fig. 1. In the objective focal plane of collimator L_1 there are two absorption gratings, *Ga* and *Gb*, of equal spatial frequency, i. e. equal grating spacing t_1. These gratings rotate around a common axis with equal angular velocities but in opposite directions. The rotation axis is parallel to the optical axis O_1 of collimator L_1, and the distance between the axes is H. The grooves of grating G_a when cross-cutting those of grating G_b develope a set of moiré fringes. Rotation of the gratings causes a cyclical change in the spatial frequency of the set fringes, i. e. a cyclical change in the spacing of fringes T_1. During every full circle of the gratings the fringes converge to the rotation axis O_2 and diverge from it twice. Thus the fringes move in the K direction in the collimator field. A light source S_1 sends off light through collimator L_1 and an image D of the set of fringes arises in the focal plane of the measured lens L_2. Behind the lens L_2 there is a reference grating G_2 of grating spacing t_2, and a photocell PH_1 behind the grating. The grating G_2 can be displaced along the optical axis O_1. Let us assume that the grating G_2 is placed in the focal plane of the lens L_2, so that the distance Δ equals zero. Then the moving fringes of the image D create an elementary light signal of cyclical variation in intensity behind every slit of the grating G_2. If these elementary signals are not in phase, the total light flux arriving at the photocell remains constant. However, once the elementary signals become in phase, that is when the distance T_2 between the fringes of image D equals spacing t_2, a short frequency signal arises in the flux. This occurs four times during each full turn of the

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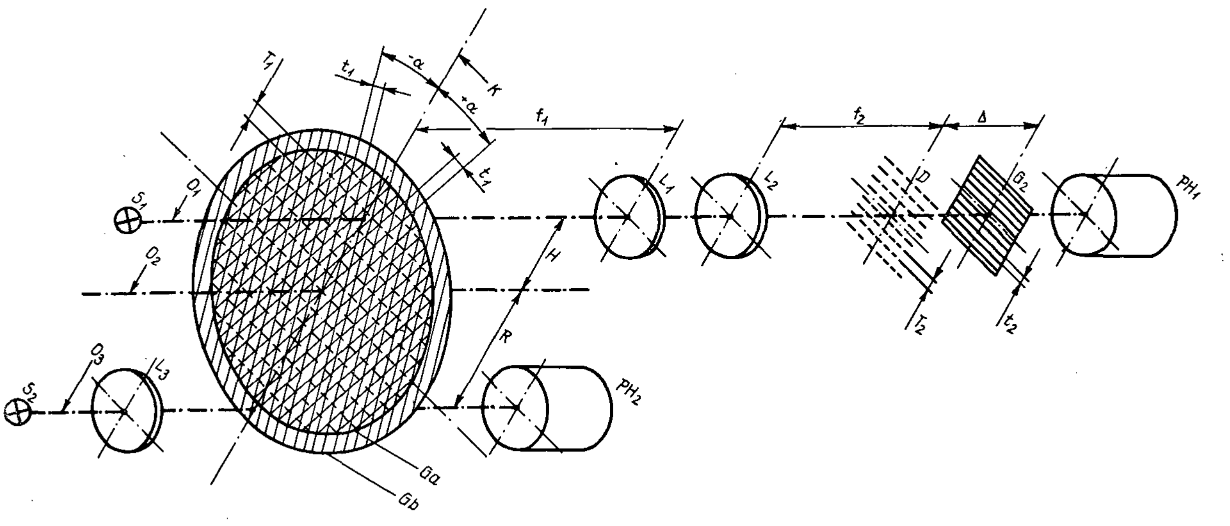

Fig. 1

gratings G_a and G_b, in particular when the grooves of the gratings are at the angle 2α to each other, whereas

$$\sin\alpha = \frac{t_1 \cdot t_2}{2t_1\, t_2}.$$

The amplitude of the frequency signal is the greater the smaller is the distance Δ between the grating G_2 and the image D. Owing to this dependence a precise focusing of the instrument is possible, which consists in placing the grating G_2 in the focal plane of the lens L_2.

The measurement of $\sin\alpha$ is done by means of a device consisting of a light source S_2 of the objective L_3 and the photo-detector PH_2. The optical axis O_3 of this system is at the distance R from the rotation axis O_2 and lies in the same plane as axes O_1 and O_2. The objective L_3 projects a light ray on the edge of the rotating grating G_b and the grooves of the grating break the ray, so that the photo-detector PH_2 receives a pulsing light signal. While the gratings G_a and G_b turn by the angle 2α, i. e. during the time passing between the two successive frequency signals in the photo-detector PH_1, $2\,m$ impulses enter the photo-detector PH_2, where

$$m = \frac{R \sin\alpha}{t_1}.$$

A suitable gate of an electronic system controlled by frequency signals separates that series of impulses and a digital computer indicates their number $2\,m$, which is proportional to the measured focal-length f_2, determined by the formula:

$$f_2 = \frac{f_1\, t_2}{R}\, 2\, m.$$

The instrumental constant can be chosen so that the parameter $2\,m$ expresses the focal-length f_2 in predetermined units, e. g. in millimeters or micrometers.

The digital computer of the electronic system indicates correct focal-length f_2 after the instrument has been precisely focussed, which can be inferred from the reading of a meter which measures the amplitude of the frequency signal.

In the COL a model of the instrument for measuring the absolute focal-length has been made with some differences in its optical system with respect to the diagram in Fig. 1. It was found that the error in measurement of the focal-length does not exceed $0.001\, f_2$. Details of the design and parameters of the instrument are due to be published after constructing a prototype.