MEASURING CURRENT IN ELECTRICAL CIRCUITS USING A POLARIMETER

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The measuring amperage is a typical task for electrical circuits. This process is carried out using special devices - analogue and digital ammeters.

In the presented work, an optical method for measuring the current is proposed. Its work is based on the functional dependence of the change in the parameters of polarized light in the polarimeter on the values of the variable current. The measuring device consists of the following functional units: an input device, a polarimeter and an indicator or recording device. Depending on the measurement tasks, a converter can be placed in front of the input device to change the input parameters of the current or convert the current from AC to DC. The input device provides high impedance and extended measurement range. The polarimeter consists of a light source, polarizer, Faraday cell, analyzer, photodetector. An infrared laser is used as a light source. A polarizer converts light from an infrared laser into monochrome linearly polarized light. The Faraday cell contains an electromagnet to create a magnetic field and a yttrium ferrite garnet crystal $YFeO$. It is a sensitive element of the polarimetric system and is designed to rotate the plane of polarization of the beam depending on the change in the magnetic field. The analyzer is used to determine the angle of rotation of the plane of polarization. The photodetector is used to convert an optical signal into an electrical one.

The principle of operation of a polarimetric device for measuring current is as follows. The measurement current is fed into the Faraday cell to an electromagnet, which creates a magnetic field around the yttrium-ferrite garnet crystal. The crystal becomes optically transparent under the influence of a magnetic field. Therefore, polarized laser radiation passes through it unhindered. At the same time, it changes the angle of rotation of the plane of polarization depending on the magnitude of the magnetic field, which is created due to the measured current. The greater the magnetic field, the greater the angle of rotation of the plane of polarization. The amount of its change is recorded using the analyzer. After the polarized light beam has passed through the analyzer, it hits the photodetector. In it, an optical signal is converted into an electrical one, followed by amplification through an amplifier and supplying it to an indicator or recording device.

The proposed type of construction of a current meter based on a polarimeter makes it possible to reduce the dimensions and weight of the device to miniature dimensions. Also, this design can significantly improve the accuracy of the current measurement. Low power consumption and other aforementioned advantages provide the possibility of widespread use of the proposed device in various fields of technology, including aviation instrumentation.