An IT was built with the following parameters: control winding wattage of 0.1 W, reed relay circuit wattage of 1 mW, zero drift of 0.1 A/m, temperature range from -100°C to +200°C, and 4 × 4 × 11-mm dimensions.

The magnetic field intensity meter with the upper limit of 1·10^6 A/m, which has been built based on this IT, has a sensitivity of 50 scale divisions/(A·m⁻¹), nonlinearity of 0.5% (on the linear section of the calibrating curve), and a measuring loop wattage of 0.2 W. It is 50 × 100 × 120 mm large and its mass is 0.5 kg.

If the regular electric circuit voltage is used instead of the sawtooth voltage generator, the magnetic field intensity meter based on the same IT has the following parameters: zero drift of 1 A/m, nonlinearity on the climbing section of the calibrating curve of 6%, 50 × 80 × 100 mm dimensions, and 0.3 kg mass.

LITERATURE CITED

FREQUENCY RESPONSE AND THERMAL MODEL OF A WIRE BOLOMETER

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When calculating the frequency response and spectrum of bolometer noise a thermal balance equation is employed to describe its dynamic properties, namely,

\[ C \frac{\partial \theta}{\partial t} + G \theta = p \]

which associates the variable constituents of the bolometer's temperature \( \theta \) and the power \( p \) in it. Such an equation represents a bolometer as a thermal system that is characterized by lumped parameters — the heat capacity \( C \) and the heat-exchange coefficient \( G \). The equation has been derived for the condition \( \theta_m \ll T_0 \), where \( \theta_m \) is the amplitude of the bolometer's temperature variations relative to its mean temperature \( T_0 \). For this way of describing a bolometer's frequency response a single parameter, its time constant \( \tau \), is found:

\[ \frac{U_f}{U_{f0}} = \sqrt{\frac{1}{1+\omega^2\tau^2}} \]

Here \( U_f \) and \( U_{f0} \) are the voltages on the bolometer at the corresponding frequencies \( f \neq 0 \) and \( f = 0 \); \( \omega = 2\pi f \).

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As is well known, the real frequency response of a bolometer differs from that of Eq. (2). At low frequencies ($\omega < 1/\tau$) no flat part is observed while at high frequencies the response decreases more slowly than in Eq. (2). The difference results from the approximate nature of the bolometer's thermal model used when deriving Eq. (2) where the parameters $C$ and $G$ are not meant to depend on frequency.

In the present article results are presented from an experimental study of frequency responses for various bolometer designs made from fine platinum wire (a fiber) 1.5 μm in diameter over a frequency range between 2 Hz and 10 kHz, as well as results of a test of a thermal model for a bolometer based on an investigation of the frequency functions, for the equivalent thermal parameters of bolometers along with a qualitative explanation of the behavioral characteristics of these functions.

The frequency responses were measured in a frequency-conversion mode. When two high-frequency signals whose frequencies $f_1$ and $f_2$ are close are supplied to a bolometer through which a direct current is flowing, then the expression for the power $p_\omega$ in Eq. (1) will have the form (when $\theta_m << T_0$):

$$p_\omega = p_m \sin(\omega t + \theta) + \sum_{i=0}^{2} \Gamma_i P_i,$$

where $P_i$ is the mean value of the power arriving at the bolometer from a source with the number $i$; $\Gamma_i$ is a parameter of the connection diagram [1] that characterizes the degree of coupling between the bolometer and these sources ($|\Gamma_i| < 1$); the number $i = 0$ corresponds to the dc source; $\alpha$ is the temperature coefficient of the bolometer's resistance at the working temperature $T_0$. The first term in Eq. (3) represents the primary power variation in a bolometer which occurs with an amplitude $P_m = 2\sqrt{P_1 P_2}$ and a frequency difference $f = f_1 - f_2$. The bolometer's temperature, and so also its resistance, vary at this same frequency. Owing to the dc these resistance variations are converted into ac having the difference frequency $f$. Thus a frequency conversion of two high-frequency signals takes place in the bolometer [1]. Equation (3) was obtained by averaging the total power in the bolometer over a time interval $\Delta t$ which satisfies the condition $1/f_1,2 << \Delta t << 1/f$. Therefore, there are no high-frequency terms in it.

The second term in Eq. (3) depends on the fact that when the bolometer's temperature changes, the powers entering it from all the sources will change, i.e., internal feedback occurs (also called an electrical interaction). As a result, the time constant $\tau$ of the bolometer connected in the electrical circuit differs somewhat [2] from its thermal time constant $\tau_0 = C/G$:

$$\tau = C/(G - \alpha \sum_{i=0}^{2} \Gamma_i P_i),$$

and the shape of the frequency response per Eq. (2) depends on the parameters of this circuit. In order to eliminate the effect on the bolometer's frequency response of its connecting-