

## BOOK REVIEW

**Thermoresistors and their Application, (Termorezistory i ikh primeneniye), A. G. SHASHKOV, 320 pp. Izd. "Energiya", Moscow (1967).**

THE MONOGRAPH "Thermoresistors and their Application" by A. G. Shashkov is mainly devoted to consideration of principles of constructing measuring systems with thermoresistors which ensure registration of parameters of streams varying in time.

The urgency of the problems considered in this book is obvious since the progress of a number of branches of engineering and research depends at present upon rapid and correct registration of dynamic parameters of the stream.

It is important to note that the problem stated in this monograph is solved as a complex electrothermal one, namely, the relationship between internal processes in electric circuits with thermal dependent resistances and the processes of their external energy transfer with the ambient medium is studied. Such an approach has helped the author to understand the phenomena in circuits with thermoresistors and to discover in their behaviour new qualitative effects such as, for example, the presence of instability of a system, the onset of self-oscillations, etc in some cases.

Chapter I deals with the main concepts on temperature and voltage-current characteristics of thermoresistors of direct and indirect heating. Here such important parameters as the coefficient of dispersion of a thermoresistor, the power coefficient of resistance (coefficient of energetic sensitivity), dynamic resistance and dynamic dispersion coefficients are introduced.

In this chapter the section devoted to consideration of static characteristics with a complex temperature dependence of resistance is, in particular, of great interest.

Such investigations on thermoresistors give the possibility to find the scope of their practical applications.

Transient processes in circuits with thermoresistors are considered in Chapter II. Here the author determines the main dynamic parameters of thermoresistors: heat capacity, dynamic coefficient of power dissipation, thermal constant of time, electric constant of time, dynamic multiplier, etc. These parameters are then widely used by the author when analyzing phenomena in circuits with thermoresistors.

The ways of the graphical construction of the curves for transient processes in circuits with thermoresistors due to external and internal disturbance and, in particular, due to the relay effect are examined in detail.

In Chapter II the methods for determining thermal constant of time and heat capacity of thermoresistors are of special interest.

In our opinion, the problem on determination of thermo-physical constants of thermoresistors should be worked out in detail.

In Chapter II the emphasis is given to the introduction of the concept on a linear model of a thermoresistor, by which is meant the system of the linear equations which approximately describe electrothermal processes in a thermoresistor.

On the basis of the systems of the linear equations the author has constructed structural schemes of different circuits with thermoresistors which are widely used for formulation and solution of a number of problems when analyzing transient processes in these circuits.

Chapters III and IV are accordingly devoted to self-excited oscillations and forced ones in circuits with thermoresistors. The conditions of self-excitation of oscillations in a circuit "thermoresistor-capacity" and of stability, and the expression for frequency of self-excited oscillations are derived.

Analytically it has been shown that self-excited oscillations may appear only when choosing a test point at the falling portion of the curve for a static voltage-current characteristic of a thermoresistor, the dynamic voltage-current characteristic having the shape of the closed curve described by the ellipse equation, that is confirmed by the author's experiments.

For non-sinusoidal self-excited oscillations it has been shown that varying either regime parameters, or values of contour elements (active resistances and capacity) it is possible to effect the shape of a curve for self-excited oscillations.

All the data on self-excited oscillations presented by the author may be effectively used in schemes of temperature measurements at any laws of a change in a temperature.

The effect of e.m.f. of large and small amplitude upon a thermoresistor is considered.

Rather good description of small current and voltage oscillations in circuits with thermoresistors by means of linear differential equations allows comparatively simple synthesis of different infra-low frequency correcting circuits.

The equation for the dynamic characteristic of a polarized thermoresistor is obtained, and it is shown that if such a characteristic is recorded experimentally it is possible to determine a thermal constant and a dynamic multiplier of a thermoresistor.

Chapter V mainly deals with the problems on the practical use of the physical properties of the thermoresistors described in the first four chapters. In this chapter the basic principles of constructing the structural schemes of measuring circuits are also considered.

The analysis of the effect of heat leakage through feeding leads upon the response time of a thermoresistor is of great interest.

Chapter VI is devoted to measuring mean and pulsation components of parameters of turbulent flows. Here the thermoresistor hot-wire anemometer is described which is

suitable for measuring a slowly varying velocity of the air flow.

To our mind, the author's recommendations on measurement of turbulent flow velocities with the help of thermoresistors, his mathematical analysis of processes of measurement of turbulence and the proposed structural scheme of measurement of small velocity fluctuations are very valuable for a further study of turbulent flows.

The material of Chapter VII is original and devoted to measuring low pressures of gases with the help of thermoresistor circuits. Here the author analyses laws of heat transfer in rarefied gases, considers the experimental data presented and describes a semi-conductor thermoresistor vacuum gauge developed for measuring low pressures over a wide range from 1 atm to  $10^{-3}$  mm Hg.

Chapter VIII is of independent interest in which the author considers the problems on measurement of thermal

conductivity of a gas and on control of concentration of components in gas mixtures.

The theoretical analysis of the possibilities of continuous measurement of concentration and thermal conductivity of gas mixtures is of great significance for development of measuring technological schemes.

Chapter IX deals with the application of thermoresistors in schemes of measuring thermophysical characteristics. The material presented in this chapter is of great importance in practice.

The monograph by A. G. Shashkov has made a great contribution to the development of the theory and practice of thermal measurements.

This monograph is useful because here complex properties of electric circuits with thermoresistors are analysed with regard for fundamental laws of heat transfer.

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## ANNOUNCEMENT

### FOURTH INTERNATIONAL HEAT TRANSFER CONFERENCE

THE FOURTH International Heat Transfer Conference will be held in Paris-Versailles from 31 August to 4 September, 1970. It is being organized by a joint French-German Committee with strong international support. About 350 papers have been selected out of 750 which had been offered. The adopted papers (4400 pages in eight volumes) will be mailed to all who have registered early for the Conference. The conference languages will be English, French and German, with simultaneous translation. As the number of participants is limited due to the local facilities, registrations should be made as soon as possible with

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Preliminary Programs, listing all papers accepted, can be requested from Congrès Services.