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RESONANT EFFECTS IN AN ELECTRIC CIRCUIT WITH PERIODICALLY CHANGING PARAMETERS

N. D. Biryuk, Yu. B. Nechayev, and V. N. Fin'ko

Voronezh State University, Russia

One of three possible manifestations of resonance in a parametric circuit is considered, which is the direct generalization of ordinary resonance. It turns out that inaccurate interpretation of the ordinary resonance becomes an obstacle for extending it to the parametric loop case. Because of this, particular emphasis in this work is placed on the ordinary resonance phenomenon. For the first time the parametric circuit resonance is considered in the situation when all the circuit elements are periodic functions of time.

The resonant phenomena in a parametric circuit with periodically varying parameters are highly diversified. The theory of this phenomenon was being developed in numerous periodicals and monographs — beginning from the ideas put forward by L. I. Mandelshtam [1] and used subsequently by G. S. Gorelik for creating the theory of resonance of parametric circuits [2]. This theory gained high recognition in the works of N. D. Papaleksi [3]. Nevertheless, this theory and further publications are hardly sufficient if considering them from the viewpoint of present-day requirements. In the work below we make an attempt, from the one hand, to simplify the theory of parametric circuit resonance, and on the other — to extend the field of its application. First of all, let us establish a strict line of demarcation between two concepts, almost coincident in their names but quite different in essence — the "parametric resonance" and "resonance of a parametric loop".

The first one refers to the case of the free (transient) process of a parametric circuit (loop) composed of positive components, particularly, when the free process of the parametric loop is ascending infinitely with time. The parametric resonance is inherent only in parametric circuits and is not observed in ordinary circuitry.

The resonance of a parametric circuit refers to the forced oscillations and represents a special response to a perturbing action. Since the ordinary circuit is a particular case of the parametric one, the ordinary resonance is also a particular case of the parametric circuit resonance. A. A. Andronov characterized the situation as follows: the systems with fixed parameters represent a "wildly specific case" of linear systems. Just in the same manner, the ordinary circuit is a "wildly specific case" of the parametric one and, therefore, the ordinary resonance is an extremely degenerated resonance of the parametric circuit.

Note that usually both phenomena are considered as independent of each other, although there is deep implicit relation between them. The reason is that the forced process can be expressed through the free process by the method of variation of parameters. To comprehend the state-of-art of the problem, it is desirable to make a retrospective journey into the history of science. The parametric resonance was discovered long ago (rocking the swings by a person). The similar situation was thereafter applied to the free process in an electric loop with a periodically varying capacitance. The theory of resonance of a parametric loop [2] was developed much later — with a large number of publications on the issue. However, the full solution of this problem is absent up to the present. Among publications in the last few years, directly related with the topic, several ones deserve special attention [4–7]. As for the works devoted to the parametric circuit resonance, they are scarce in

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