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INCREASING OF EXACTNESS MEASURING SENSORS IN CONTROL SYSTEMS BY TECHNOLOGICAL PROCESSES

In paper presented ways to increasing exactness of technological parameters control for capacity sensors in control system by technological processes.

Sensors based on resonant circuit are used in automatic control system by the technological processes for food and grain processing spheres of industry. For example, sensors for raw material (processing products) control of humidity and loading in technological capacities. The dielcometric control method is more appropriative for this purpose [1]. The resonant methods of measuring of electric capacity are widespread enough [2]. Differential method of small capacities measuring on the lateral branch of resonant curve used for decreasing of the measuring errors related to instability of frequency and amplitude of generator voltage and instability of parameters oscillating circuit [4, 5]. Well-known devices [3] don't provide high exactness for measuring of electric circuit resonant frequency.

We may to promote exactness of resonant frequency measuring for electric network by exception of error in the indication of phase change $\pi/2$ at the change of resonant frequency in a wide frequency range.

In Figure 1 presented flow-chart of device for measuring of electric circuit resonant frequency. Device for measuring of electric circuit resonant frequency [3] contains a variable frequency oscillator 1 hanging by electric circuit at the output; electric circuit formed by the inductances spools 2 and 3that are connected, winded on toroidal cores; condenser 4 with the winding connection 5 that come through toroidal cores. Outputs of spool 3 connected with the entrances of automatic switch 6, the management circuit ofthat is connected to the LFO of rectangular voltage 7. Output of automatic switch 6 connected with the first entrance of differential amplifier 8 and the second entrance connected with the output of HFO 1 through attenuator 9. General point of differential amplifier 8 connected with the middle point of spool 3 and earthed. Output of differential strengthener 8 connected with consistently included amplitude detector 10, a selective amplifier 11 that adjusted on frequency of LFO 7, a phase-sensitive rectifier 12, the management winding of that is also connected to the rectangular voltage LFO 7. Output of phase-sensitive rectifier 12 through integrator 13 connected with the managing entrance of HFO 1. The output of HFO is connected with digital frequency meter 14.

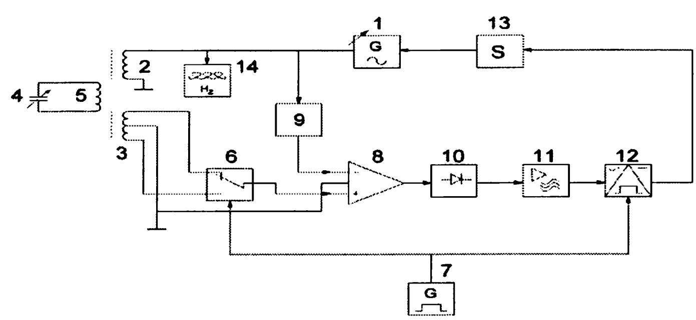

Fig. 1. Schematic of device for electric circuit resonant frequency measuring.

A device works in the following way. High-frequency signal from the output of variable frequency oscillator 1 comes on a spool 2 and forms in her core the alternating magnetic field that excites a high-frequency current that contain condenser 4 with the winding connection 5. High-frequency current in the core of spool 3 creates the alternating magnetic field and corresponding high-frequency voltage.

Amplitude and phase of high-frequency voltage of spool 3 it is determined by an impeder to the circuit at presence of winding connection 5. Resistance to the circuit is capacity if the frequency of excitation is less then resonant frequency, and inductive if the frequency of excitation more than resonant. Circuit resistance is cleanly pure resistance if the high-frequency oscillations frequency coincides with resonant frequency. Spool 3 connected by an automatic switch 6 to one of entrances of differential strengthener 8. It appears loaded on practically endless resistance in different frequencies. Therefore it works in the mode of idling and formed the phase change that equals $+\pi/2$ in relation to the current of winding connection 5.

Phase of current to the circuit, and, as a result, current of winding connection as to variable frequency oscillator 1 can be variable from $-\pi/2$ to $+\pi/2$d depending on relative disorder to the circuit. It happens if the circuit is imbalance in relation to frequency of own resonance. As a result of it a phase voltage change on the output of spool 3 in relation to the phase of voltage of variable frequency oscillator 1 can change from 0 to π in the change of frequency of high-frequency signal in wide limits. Phase change, that is brought in by an electric circuit that consists of spools 2, 3 condensers 4 and winding connection 5 is equal $\pi/2$ if the resonance to the circuit 4, 5. The last one is used for the indication of resonance of electric circle. To the one of entrances of differential strengthener 8 through attenuator 9 continuous voltage of generator For the receipt of signal, that are phase change proportional rejection from $\pi/2$, and to the second entrance alternately of voltage from the conclusions of spool 3 in relation to the earthed middle point. Frequency of switching of voltage pool 3 set by frequency of LFO 7 and tension that manages of switch 6 work. So as tension of conclusions of spool 3 in relation to a middle point are in anti phase, then at one position of switch initial tension of differential strengthener 8 proportional to the vectorial difference of entrance voltage, and at other to the vectorial sum. At the change of phases, even $\pi/2$, amplitude of difference voltage is equals amplitude of total voltage independently from correlation of amplitudes on the entrances of differential strengthener. In case of increase of phase change ($\varphi = \frac{\pi}{2} + \delta$) difference voltage is grows, and the total is decreasing. At deviation of phase change from $\pi/2$ in other side ($\varphi = \frac{\pi}{2} - \delta$) total tension becomes more difference. As a result of continuous work of switch 6 with frequency of LFO 7 for differential strengthener 8 is appears modulated on amplitude with frequency of commutation of voltage spool 3. The voltage is distinguished by a amplitude detector 10. It increases a selective amplifier 11 that adjusted on frequency of LFO 7, and becomes straight phase-sensitive rectifier 12 on the managing entrance of variable frequency oscillator 1 by changing frequency of vibrations in the direction of rapprochement with resonant frequency to the circuit 4, 5. At the coincidence of variable frequency oscillator 1 with resonant, difference voltage on the output of differential strengthener 8 the even becomes total and amplitude modulation on the entrance of detector 10 is disappears. Output voltage of integrator 13 the retains frequency of generator resonant 1. At phase change deviation from $\pi/2$ as a result of circuit 4 capacity change there is circumflex in output voltage of differential strengthener 8, voltage of that then the phase sensitive straightening additionally charges or discharges integrator 13. Integrator 13 changes frequency of variable frequency oscillator 1 to the new value of resonant frequency to the circuit 4, 5. The value of the resonant frequency is measured by a digital frequency meter 14. Instability of integrator 13 and other converting units (detector 10, amplifier 11 and rectifier 12) do not affect the accuracy of the oscillator 1, the resonant frequency of the circuit, as well as equality of difference voltage total does not depend on the settings and the form of amplitude-frequency characteristics of intensive-rectifier tract (8, 10, 11, 12).The weakening of the attenuator 9 is chosen from the equalization conditions of differential amplifier 8 input voltages with an average of the difference frequency. But arises the inequality of summary or voltage difference by changing the resonant frequency over a wide range that doesn't affect the accuracy of detection of the phase deviation from $\pi / 2$.

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