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Application of the Electromagnetic Vibration Drive in Intensive Vibrotechnologies of Water Sector

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ABSTRACT: The article deals with the application of a controlled electromagnetic vibration drive for intensive vibration technologies in the water sector. A method is proposed for regulating the amplitude and frequency of the working body of the vibrating unit, which improves the efficiency of mechanical vibration and energy indicators.The result of a constant magnetic field, an electromagnetic field, and low-frequency mechanical vibrations on specific electrical conductivity of distilled water was studied. Newly formed (fresh), three-day- and six-day-old distilled water was used.

KEYWORDS: electromagnet, electromagnetic vibration, intensive vibration, water sector, amplitude, frequency

I.INTRODUCTION

In various fields of engineering and technology, highly efficient vibration and vibration impact machines are widely used. The variety of types and operating conditions of vibrating units determines the requirements for their basic structure, design and performance. In practice, various types are used - electromagnetic, inertial, eccentric, hydraulic, etc.The process of cleaning bulk and viscous masses from coarse fractions belongs to the field of intensive vibration technologies. The vibrating screens used in this case, equipped with eccentric or inertial drives, have significant disadvantages. At certain vibration frequencies, large forces of inertia arise in them, which are transmitted to the bearings of the eccentric or unbalanced shafts, which leads to their premature failure. In addition, the shaking mode of operation reduces the durability and wear resistance of the sieve cloth. To regulate the amplitude and frequency of oscillations in these drives, it is required to stop the machine and alter the eccentrics and unbalances[1].

II. SIGNIFICANCE OF THE SYSTEM

Recent residential and occupational epidemiological studies indicate a statistical association between 50-60 Hz magnetic field exposure and the risk of developing some kinds of tumors. Several experimental researches have been carried out in vitro and in vivo to verify the possibility that some cell functions may be influenced by ELF (Extremely Low Frequencies: 0-300 Hz) electric and magnetic fields. Such researchers are very important to assess if the statistical association indicated by the epidemiological studies is actually due to a cause-effect relationship between ELF electric and magnetic fields and carcinogenesis. In this review we describe the present state of the experimental research, focusing our attention on the effects of ELF fields on the immune system. We also describe some theoretical researches whose aim is to identify possible mechanisms of interaction between ELF fields and biological systems which may provide biological plausibility to the observed effects[2].

More advanced electromagnetic oscillation exciters of reciprocating action, while the working body receives the necessary oscillatory movements without intermediate rotation mechanisms. The electromagnetic drive has no frictional units that require constant lubrication, which significantly increases safety and ease of maintenance. The amplitude and frequency of the oscillations are very easily regulated by electrical methods without interrupting the process.

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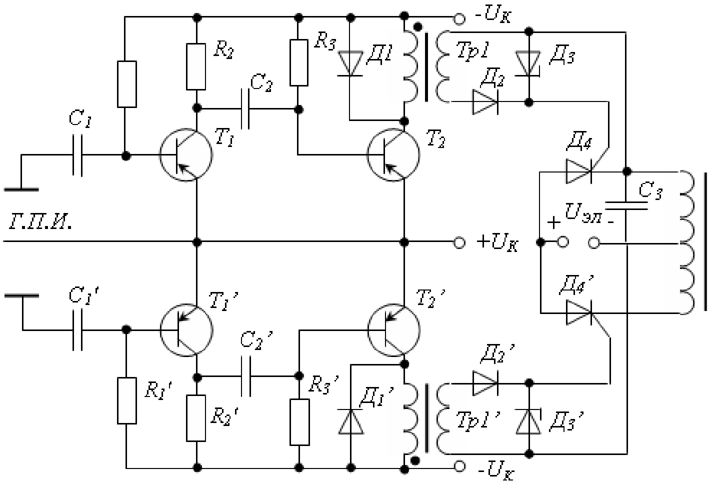

The oscillation frequency of the electromagnetic drive of the vibrating sieve (Fig. 1) is set by the sawtooth pulse generator (GPI), which produces two output voltage signals shifted by 180º (Fig. 2, a). They are fed to a two-channel differential amplifier. Capacitor C1, discharging through resistor R1, sends a pulse of positive polarity to the base of transistor T1 (Figure 2, b). The rate of its increase in this case is determined only by the duration of transient processes in the GPI. In this case, the transistor T1 leaves the saturation state and an amplified pulse of the same shape is created in its collector circuit (Figure 2, c). Then the pulse is once again differentiated by the chain R3 C2 (Figure 2, d) and in negative polarity is fed to the base of the transistor T2, removes it from the cutoff state and forms amplified pulses with a steep leading edge in its collector circuit (Figure 2, e), which through matching transformer Tr1 and diode D2 are fed to the control electrode of thyristor D4. The protection of the transistor T2 from overvoltage at the moment of blocking is carried out by the diode D1. Zener diode D3 protects the control transition, D4 from overvoltage. Thyristors every 180º connect one of the half-windings of the vibration exciter to the power supply. The switching capacitor C3 and the exciter winding create an oscillatory circuit LevC3. When the control impulses and natural oscillations of this circuit are equal, the current in the vibration exciter is maximum and is close in shape to a sinusoid (Figure 2, e).

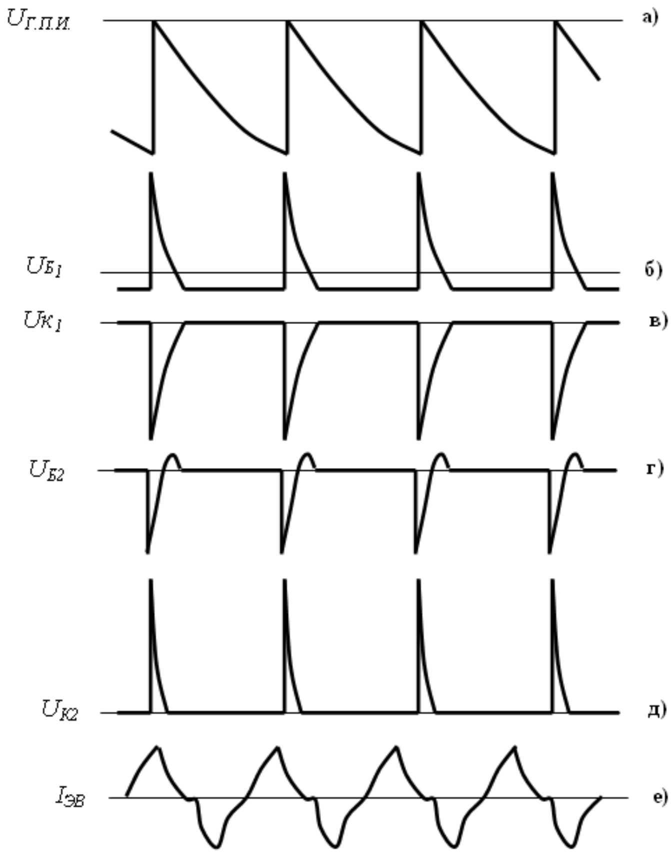

Fig. 2. Pulse oscillograms of the control circuit

The developed control system provides regulation of the vibration frequency of the sieve cloth in the range of 5-50 Hz (optimal 20-22 Hz). Their amplitude can be adjusted from 5.5 to 5 mm. For sieve openings below 0.3 mm, it should decrease and the frequency should increase. In this case, natural vibrations are excited in the sections of the sieve cloth, which are superimposed on the forced ones, due to which self-cleaning of the holes occurs even when wet and liquid-viscous materials are filtered[3].

III. LITERATURE SURVEY

The stimulation of protein and DNA by electromagnetic fields (EMF) has been problematic because the fields do not appear to have sufficient energy to directly affect such large molecules. Studies with electric and magnetic fields in the extremely low-frequency range have shown that weak fields can cause charge movement[4]. The question of whether very weak low frequency magnetic fields can affect biological systems, has attracted attention by many research groups for quite some time. Still, today, the theoretical possibility of such an interaction is often questioned and the site of interaction in the cell is unknown[5]. The effect of mechanical vibrations (MV) electrical conductivity of water and optical density of aqueous DNA solution. Distilled water was treated with MV of several frequencies from 3 to 5000 Hz with an intensity of 90 dB for 30 minutes. Different sensitivities of water specific electrical conductivity (SEC) were determined (the value of distilled water SEC was 209 +/- 2 microS/m). The greatest decrease of SEC (by 15.7%) under the influence of MV was observed at the frequency of 4 Hz. There was no effect at frequencies higher than 100 Hz. The treatment of DNA water solutions with MV of frequencies 4 and 10 Hz decreased its optical density by 4.2 +/- 1.1 and 4.8 +/- 1.2% correspondingly in comparison with control. In cases of treatment with frequencies of 20 and 50 Hz no effect was observed. The mechanism of MV effect on water can be connected with the changes of system structural characteristics. It is confirmed by experiments with DNA solution, where the decrease of optical density (at 260 nm) under MV treatment is conditioned with the increase of the probability of hydrogen binding formation between the bases[6].

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IV. METHODOLOGY

A Brownian dynamics model of cell membrane calcium ion channels exposure to ELF magnetic fields has been proposed for the first time. Based on the model, the permeation of calcium channels activation by applied magnetic fields is given here. The number of opened calcium channel is increase with magnetic fields. The currents of calcium ions in the channel in controls and exposure to ELF magnetic fields are almost the same. These results are consistent with experiments. Thus it can be seen that the current of single calcium channel was nearly unaffected by applied magnetic fields, the increased number of opened calcium channel may be the reason of increased intracellular calcium concentration[7].

V. EXPERIMENTAL RESULTS

The optimal values of the amplitude and frequency of vibrations of the vibrating sieve depend on the selected trajectory of its movement, which together determines the productivity, efficiency of filtering and the ability to self-cleaning. Since it is impossible to allow systematic clogging of the sieves, interrupting work, the last criterion when choosing the vibration parameters is paramount[8].

For horizontal vibrating screens with rectilinear vibrations (in our case, for electromagnetic), the following empirical formulas are used.

$$\alpha = \frac{4 + 140\lambda}{1000}; \qquad n = \frac{5(I + 12{,}5\lambda)}{\alpha}$$

Where n is the oscillation frequency of the web, number / min

I- size of sieve holes, mm

α- sieve vibration amplitude, mm

In this case, the angle of inclination of the sieve cloth can be 15-20º.

Checking the curve of optimal combinations of amplitudes and frequencies of oscillations using these formulas showed their admissible coincidence (Fig. 3.)

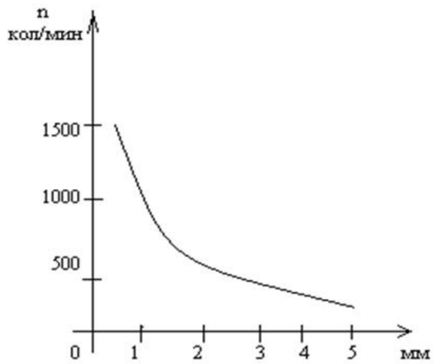

Fig 3. Curve of optimal combinations of amplitudes and frequencies.

Thus, the development of an electromagnet vibrating sieve that allows controlling vibration parameters during sieving and cleaning bulk materials is relevant and necessary.

VI. CONCLUSION AND FUTURE WORK

The variety of types and operating conditions of vibrating units determines the requirements for their basic structure, design and performance. In practice, various types are used - electromagnetic, inertial, eccentric, hydraulic, etc. The effect of a constant magnetic field, an electromagnetic field, and low-frequency mechanical vibrations on specific electrical conductivity of distilled water was studied. Newly formed (fresh), three-day- and six-day-old distilled water was used. The exposure of distilled water to a constant magnetic field (2.5 mT), electromagnetic field (2.5 mT and 1-

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100 Hz), low-intensity mechanical vibrations (1-100 Hz) with an intensity of 30 Db led to a reduction of its specific electrical conductivity. It was found that, as water aged, the effect of these factors on the specific electrical conductivity decreased[9].

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