Journal of Physics: Conference Series

PAPER • OPEN ACCESS

Way to Protect Electrical Wires Against the Break under the Strong Wind

To cite this article: Evgeniy Kobelev *et al* 2020 *J. Phys.: Conf. Ser.* **1626** 012056

Way to Protect Electrical Wires against the Break under the Strong Wind

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Abstract. In many countries in the world the strong wind can break wires very easily. In this case many regions and very important objects will be without of the electrical energy and lighting. To find quickly the place where this situation had happened it takes many hours. It is a great problem. Everybody knows that it is rather difficult to reach this damaged place (maybe in the forest or among the high hills). Strictly any repair takes usually many hours too. That's why it is needed to find the simplest method to defend any long wires against their break under the strong wind. In this situation if the strong rushes of the wind begin to swing wires intensively, they cannot sustain such overloads too long. Moreover, the resonance phenomenon in these oscillations will be without fail and breaks wires very quickly. In this article there is a new way how to protect any wires against the break using only several hard rods fixed firmly on the wires. How it can be done it is described in detail below and some of recommendations including the results of experiments are shown also.
Keywords: Protection; Electrical wires; Oscillations, Strong wind; Break; Effective design, Experiment.

1. Introduction

Firstly, there is some information connected with the oscillations and waves [1]. The traditional equation for the harmonic oscillation is the next [2, 3, 4]:

$$x = A\sin(\omega t + \varphi_0), \quad (1)$$

where x is the physical quantity (displacement) which completes the oscillatory movement;
A is the amplitude of the oscillation;
ω – circular frequency ($\omega = 2\pi\nu = 2\pi/T$);
ν – frequency of the periodical and total oscillations which take place during the definite time t;
T – period of oscillations;
φ_0 – the initial phase/stage of oscillations.

Periodically, many systems can have the negative oscillations if frequencies for the free oscillations and for the forced oscillations will agree. In this situation there is such effect as a resonance and the amplitude of oscillation begins to strive for the endlessness ($A \to \infty$).

All dependences for x (displacement), a (acceleration)and for v (velocity for the harmonic oscillation) are given below (figure 1).

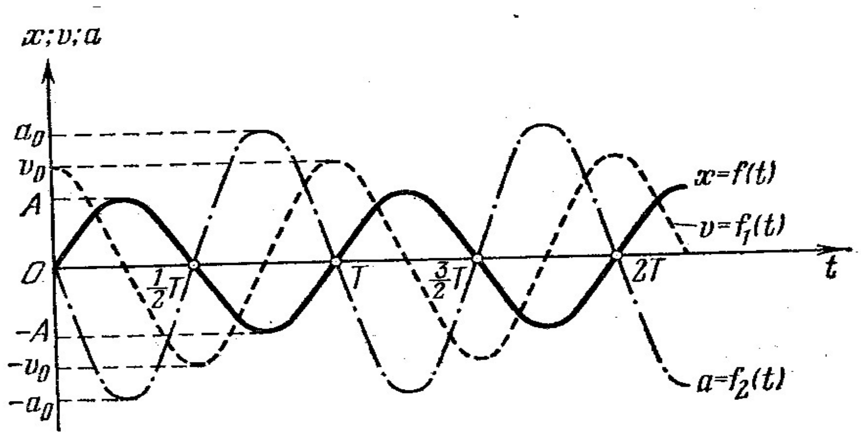

Figure 1. Dependences as a curves for the *x*, *a*, *v* if the initial phase/stage $\varphi_0 = 0$: a_0 – amplitude of acceleration ($a_0 = \omega^2 A$); v_0 – amplitude of velocity ($v_0 = \omega A$).

The velocity for the harmonic oscillation has the next formula:

$$v = \omega A \cos(\omega t + \varphi_0) = v_0 \cos(\omega t + \varphi_0) = v_0 \sin(\omega t + \pi/2 + \varphi_0). \quad (2)$$

Let's designate the process of damping for our amplitude *A* of oscillation as $\delta = r / 2m$ where *r* is a coefficient of friction and *m* is a mass for the mechanical system which has the oscillation (figure 2).

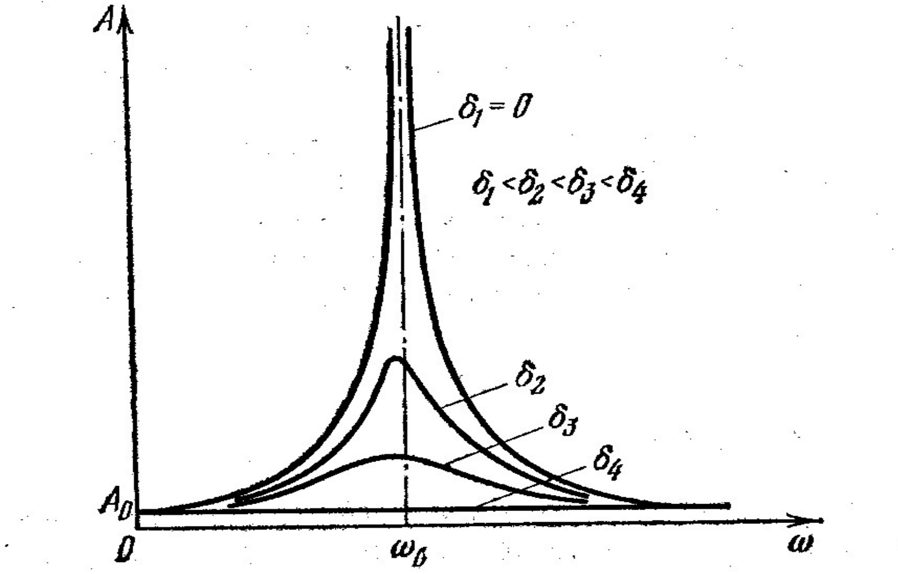

Figure 2. Influence between different δ and amplitude *A*.

2. Method to Protect Electrical Wires

Thus, strong wind will always swing any long wires very violently [Figure 3). It calls the resonance phenomenon and the overload. In the end the wire will be torn. To eliminate this negative moment a new way and experiment were suggested.

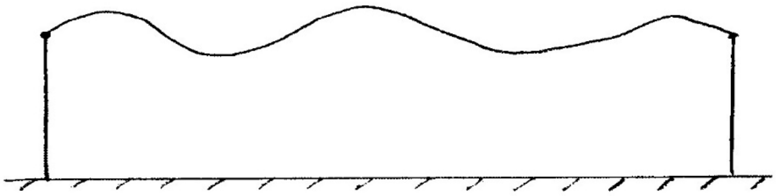

Figure 3. Example of standard oscillation.

Evidently, it is needed to change the thickness practically in each metre of the wire length. In this case the character of oscillation will not be as a harmonic with the great amplitude. To confirm this primary assumption, the next actions were done. Several hard thin rubber rods were bought and such elements like a clutch/clamp to fasten them to the wire. Originally the standard length of the rod was 1.5 m but we had cut it on the different dimensions (for example, 1.2; 1.0, 0.8, 0.5 m). These portions were fastened to the wire with the different distance between of the two nearest parts. Moreover, the long tow-rope was bought (about 35 m). One of the end of this tow-rope was fastened to the hook on the wall. The second end of this tow-rope was into the researcher's hand. If this second end we begin to shake intensively (ups and down), the big waves appear on the tow-rope (figure 4 and figure 5).

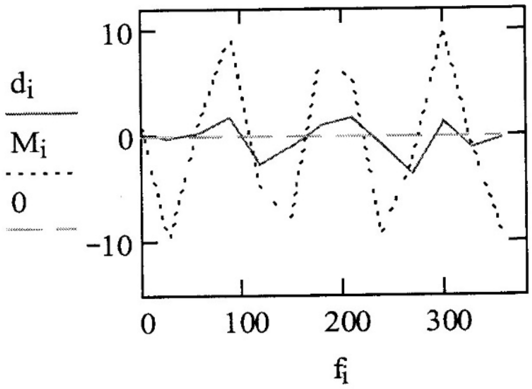

Figure 4. Character of oscillations for different situations, namely: unbroken line shows the oscillation if the new way to diminish it was applied; the dotted line shows the typical oscillations.

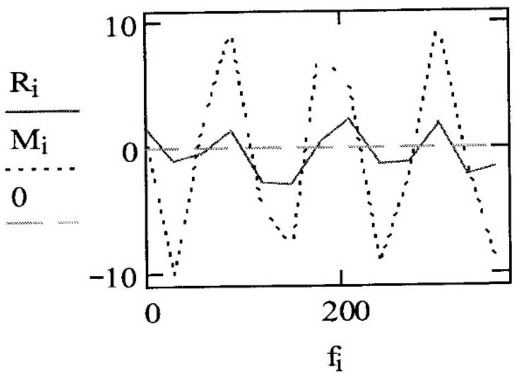

Figure 5. Results of oscillations during the second experiment.

Quite the contrary the picture of oscillations with the rubber (or plastic) portions will be fastened on the tow-rope. Using special technical literature (books, text-books, articles, patents and computer programme MathCad [1, 5-8]) the new way to diminish the amplitude of oscillation was received.
Before the end of this article some words about waves and their oscillations [9-12]. If there are two linked by a spring pendulums, and one of them has an impulse to start the oscillation. Then the wave of additional oscillation will go to the second pendulum. Let's the distance between of two pendulums is z. The displacement for this pendulum will be $x(t, z)$. Then the next formula can be applied:

$$x(t, z) = A \cos \omega \, (t - z/u), \quad (3)$$

where u is the velocity.
Moreover, the length of the wave will be the next:

$$\lambda = (2\pi / \omega)\, u = uT, \quad (4)$$

where T – period of oscillation;

ω – frequency.

The wave oscillation can be calm using the next way. Cover the water surface with the oil: the fatness - about 15 mm will be usually enough [13, 14]. Moreover. The industrial oil can dissolve such carcinogenic gas as H_2S.

3. Conclusion

Made analysis showed that suggested way to protect any electrical wires against the break under the strong wind is the simplest in the world. It doesn't demand much money to realize it in practice. Moreover, it has very high reliability during the operation and it guarantees the full safety. Any others technical well-known decisions connected with this problem lose with respect to this suggestion.

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