CHARACTERISTICS OF THE ELECTROMECHANICAL WATCHING TENSION DEVICE FOR WINDING COILS FROM THIN WIRES.

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ABSTRACT
It is considered features power characteristics watching tension the device for winding wires of small sections are received is found a condition of performance of stabilization of force of a tension of wires during winding.

Keywords: characteristics, features power, stabilization, during, mechanism.

1. INTRODUCTION

At carrying out works during manufacturing coils by one of conditions of qualitative winding and increase of speed of winding maintenance of a constant tension of a wire during winding is. In some devices, for example, in superconducting magnets, the windings executed from обмоточного of a wire in diameter less (0,06 - 0,08) mm find application.

For such devices it is often necessary to provide the certain size of active resistance of a winding. At small diameters намоточного wires essential influence on size of this resistance renders a tension of a wire during winding. Besides at winding on rectangular skeletons sharp changes of a tension of a wire take place at transition of a reeled up wire from an edge on a side of a rectangular skeleton. It can lead to breakage of a wire and demands the special device which would provide stabilization of a tension of a wire during work.

Now numerous devices (mechanical, electromechanical and qas-dynamic) for a tension of a wire are known. Most best of them contain the electronic scheme shadowing a tension of wire [1]. However similar devices possess a number of essential lacks. So mechanical tension devices inertial, have the complex kinematic scheme owing to what do not allow to spend winding of wires of small diameter up to 0,1 mm on high speeds. Devices with the electronic scheme complex, reliable and complex in manufacturing and adjustment. The principle of action of such devices is based on comparison of a signal from the gauge of a tension (inductive type) with installation and in development by the electronic scheme of a signal of management on the executive mechanism adjusting a tension of a wire.

II. FEATURES OF THE TENSION DEVICE

The named lacks are absent in the stabilizer of a tension of lengthy products which is based on linear induction hanger (fig.1). Such stabilizer of a tension of a wire works by a principle of watching system owing to what high accuracy of regulation of a tension of wire [1] is provided. Except for it is structurally simple also reliable. It consists of the converter of efforts 1 and the executive mechanism 2. Their which windings of excitation 3 and 4 are among themselves connected consistently, and in the power supply 6 are included through adjusting resistance R_1. Above windings of excitation screens 5 and 6, frameworks with the directing rollers strengthened on them 8 and 9 are located with an opportunity of oving along the central core. On the converter of efforts the winding of management 7 connected through adjusting resistance R_2 with a source of a variable pressure is in addition established. The mobile roller 9 is located between two motionless rollers 10 and 11 between which the lengthy material 15 which are taken up from the motionless coil 15 is passed, through a cone directing receptions 14 and reeled up on a skeleton 13. The device works as follows.

Windings of excitation (WE) 3 and 4 winding of management (WM) 7 are connected to a source of a variable pressure, and a skeleton 13 with the end of the lengthy material 15 which are taken up from the motionless coil 15 fixed on it, through directing cone 14 and directing rollers 8, 9, 10 and 11, resulted in rotation. Thus the screen 6 converters of efforts move before position of stable equilibrium simultaneously with it the screen 7 executive mechanisms 2 with the roller 9 strengthened on it adjusting force of friction of the reeled up material 15 about motionless rollers 10 and 11 moves.

From windings of excitation 4 and managements 7 operate repellent forces. By means of resistor R_1 the current of a winding of management 7 and therefore its force of pushing away owing to what the screen 6 can borrow any intermediate position between windings 4 and 7 is adjusted.

Thus position of the screen 6 will change also, that causes change of force of a tension of a wire.

During winding, at increase in force of a tension, the screen 6 will start to move upwards and thus inductance of a winding 4 increases, and the current in a circuit decreases, that will lead to lowering of the screen 5 and force of friction in system of rollers 9, 10, 11 so also to reduction of force of a tension decreases. For reception of installation of force of a tension by means of adjustable resistor R2 the current of a winding of management 7 which changes serves measuring force of a tension of a wire.

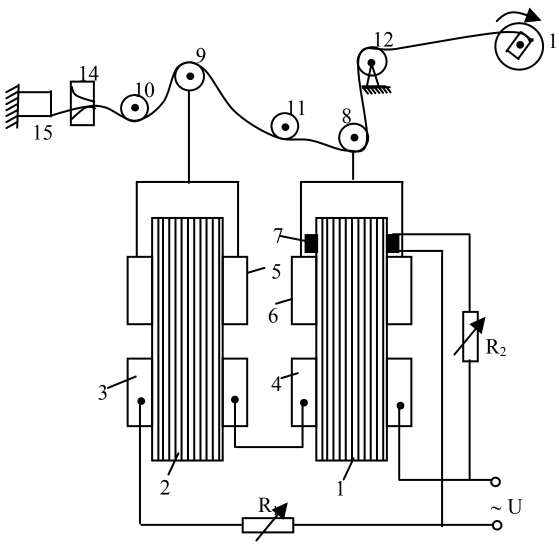

Figure 1. The basic scheme watching the tension device for winding coils from thin a wire.

Prominent features of the considered device are concluded in the following.

1. The Basic unit of the tension device is the watching system constructed on the basis of two linear inductive hanger (IH). One of them carries out the converter of efforts (CE) and the winding of management automatically adjusts forces of a tension of a wire. Resultant the force acting on the screen of the converter of efforts in this case changes.
2. The Second induction hanger (IH) carries out function of the executive mechanism (EM). At moving screen CE upwards screen IH falls downwards, that causes reduction of force of friction of rollers and by that force of a tension of a wire decreases. Current WE I_1 after movings the screen remains constants (I_1=const).

III. POWER CHARACTERISTICS OF THE DEVICE AND CONDITION OF PERFORMANCE OF STABILIZATION FORCES OF A TENSION

Power characteristics of the device we mean dependences of elevating forces levitation the screen (LS) and forces of pushing away of a winding of management from movings X. Steepness and size of these forces define accuracy of stabilization of a tension of a wire at winding.

With the purpose of definition of these forces it is necessary to know functional dependences inductance windings L from movings the screen X. As is known [1], inductance of windings in view of magnetic streams of dispersion are defined from formulas:

$$L_1 = L_0 \pm \Delta L; \qquad L_2 = L_0 \mp \Delta L \tag{1}$$

Where L_0-inductance WE for starting positions of the screen; ΔL - increments inductance

$$L_0 = L_{s1} + L_{p1} = W_1^2\lambda\left(\frac{h_1}{3} + X_0 + \frac{1}{3}h_2\right) \tag{2}$$

$$\Delta L = W_1^2\lambda X \tag{3}$$

Inductance L_1 and L_2 through moving X can be expressed as:

$$L_1 = W_1^2\lambda\left(\frac{h_1+h_2}{3} + X_0 \pm X\right); \quad L_2 = W_1^2\lambda\left(\frac{h_1+h_2}{3} + X_0 \mp X\right) \tag{4}$$

Having acted similarly, for inductance of a winding of management we shall receive:

$$L_y = L_{y0} \mp \Delta L_y = W_y^2\lambda\left(\frac{h_y}{3} + y_0 \mp X\right) \quad , \tag{5}$$

Where

$$L_{y0} = L_{8y} + L_{py} = \lambda W_1^2\left(y_0 + \frac{h_y}{3}\right) \tag{6}$$

$$\Delta L_y = W_y^2\lambda X \tag{7}$$

Currents WE and WM are defined from expressions:

$$I_1 = \frac{U_1}{2\sqrt{(r_1+R_1)^2 + (L_1+L_2)^2}} = \frac{U_1}{2\sqrt{(r_1+R_1)^2 + (\omega L_0)^2}} \tag{8}$$

$$I_y = \frac{U_1}{\sqrt{(r_2+R_2)^2 + (\omega L_y)^2}} \tag{9}$$

From here follows, that at moving LS current WE I_1 remains immutable, and the current of management I_y changes. It leads to a constancy of elevating force CE $F_{э1}$ and to change of force F_y of a created winding of management:

$$F_{Ý1} = \frac{I_1^2}{2}\frac{\partial L_1}{\partial X} = \frac{1}{2}\lambda(I_yW_y)^2 \tag{10}$$

$$F_y = \frac{1}{2}I_y^2\frac{\partial L_y}{\partial X} = \frac{1}{2}\lambda(I_yW_y)^2 \tag{11}$$

Resultant the force acting on the LS CE:

$$F_{ý2} = F_{ý1} - F_y = \frac{1}{2}\lambda(I_1W_1)^2\cdot(1-k_y^2) \quad , \tag{12}$$

Where K_y - coefficient of management

$$K_u^2 = \left(\frac{I_yW_y}{I_1W}\right)^2 = \frac{2\left[(r_1+R_1)^2 + \omega^2L_0^2\right]}{(r_y+R_2)^2 + \omega^2L_y^2} \tag{13}$$

Elevating force of the executive mechanism is defined as:

$$F_{ý2} = \frac{1}{2}I_1^2\frac{\partial L_2}{\partial X} = \frac{1}{2}\lambda(I_1W_1)^2 \tag{14}$$

Resultant elevating force CE $F_э$ compensates gravities LS $P_в$ and rollers P_{r1}. Therefore the equations of balance of mechanical forces will be as

$$F_ý = F_{ý1} - F_y = P_â + P_{r1} \quad , \tag{15}$$

or

$$\frac{1}{2}\lambda(I_1W_1)^2 \cdot (1-k_y)^2 = P_{\hat{a}} \pm P_{r1} \qquad (16)$$

Too most it is possible to write down for forces EM:

$$F_{\acute{y}2} = P_{\hat{a}} \mp P_{r2} \qquad (17)$$

or

$$\frac{1}{2}\lambda(I_1W_1)^2 = P_{\hat{a}} \mp P_{r1} \qquad (18)$$

From (16) and (18) it is defined ampere-turns WE:

$$I_1W_1 = \sqrt{\frac{2(P_{\hat{a}} \pm P_{r1})}{\lambda(1-k_y)^2}} \qquad (19)$$

$$I_1W_1 = \sqrt{\frac{2(P_{\hat{a}} \pm P_{r2})}{\lambda}} \qquad (20)$$

From here we shall receive to a condition

$$k_y = 1 - \sqrt{\frac{P_{\hat{a}} \pm P_{r1}}{P_{\hat{a}} \mp P_{r2}}} \qquad (21)$$

which performance it is required for stabilization of force of a tension.

IV. CONCLUSIONS

1. Advantages and lacks of existing tension devices for winding wires during manufacturing coils Are analysed. The advantages of the watching tension device constructed on designs linear induction hanger are shown.
2. Analytical expressions of functional dependences inductance windings and elevating forces from moving rollers Are received. On the basis of these expressions the condition of stabilization of force of a tension of wires is established. The condition of stabilization of force of a tension depends on parities of elevating force and a gravity levitation screens and rollers.

REFERENCES

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