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KINEMATIC ANALYSIS OF COMBINED MECHANICAL SYSTEMS OF SIMULTANEOUS BLADES TURNING AND FOLDING OF HORIZONTAL-AXIS WIND TURBINES

АНАЛІЗ КІНЕМАТИКИ КОМБІНОВАНИХ МЕХАНІЧНИХ СИСТЕМ ОДНОЧАСНОГО ПОВОРОТУ І СКЛАДАННЯ ЛОПАТЕЙ ГОРИЗОНТАЛЬНО-ОСЬОВИХ ВІТРОУСТАНОВОК

Розглянуто різні типи комбінованих механізмів одночасного повороту і складання лопатей, які можна використовувати з метою регулювання потужності та стабілізації частоти обертання горизонтально-осьових вітроустановок. Побудовано кінематичні схеми відповідних механізмів. Виведено аналітичні вирази для встановлення залежностей переміщень регулювальних повзунів від кутів повороту і складання лопаті.
Ключові слова: горизонтально-осьова вітроустановка, механізм повороту лопатей, механізм складання лопатей, кінематичні параметри.

Various types of combined mechanisms of simultaneous blades turning and folding, which can be used for power regulation and rotation frequency stabilization of horizontal-axis wind turbines, are examined. Kinematic diagrams of certain mechanisms are designed. Analytical expressions for ascertainment of regulation sliders displacements from turning and folding angles are deduced.
Key words: horizontal-axis wind turbine, blades turning mechanism, blades folding mechanism, kinematics parameters.

Problem stating. For effective and reliable operating of wind turbine under the conditions of changeable wind speed and direction it is necessary to equip the wind turbine with special regulation mechanisms, which usually operate at the expense of blades turning and folding or wind-wheel getting out of wind direction. The mechanisms of blades turning and folding are considered as the most effective methods of power regulation and rotation frequency stabilization of «small» horizontal-axis wind turbines (of nominal power up to 10-20 kW) [1]. However, in some exceptional cases they cannot ensure sufficient reliability of wind turbine operation, accuracy of rotation frequency stabilization or power changelessness. These problems may emerge in such cases as sudden (biting) wind gust, which is accompanied by substantial exceeding of wind speed over its nominal (design) value, and when the gale-strength climatic conditions occur. In the first case, sudden raising of the wind speed causes practically stepwise increasing of the wind turbine rotation frequency and power as a result of large detention lag of the regulation mechanism actuation. Under the gale-strength climatic conditions the wind turbine submits to the influence of changeable direction and intensity of the wind loading and of the atmospheric precipitates. In such conditions the presence of single mechanical regulation system (of blades turning or folding) rarely ensure wind turbine operation capacity saving, taking into consideration a number of construction faults of each mechanism.

That's why the investigations, aimed at improving of existent mechanical systems of power regulation of small horizontal-axis wind turbines, are very actual at present. The kinematic analysis of new proposed constructions is one of several stages of such investigations and may be carried out with the purpose of determination of kinematic parameters cooperativeness with desired operating conditions. Also kinematic analysis data may be used for realization further dynamic investigations and solving such problems as synthesis and optimization of mechanisms constructions.

Analysis of recent investigations and publications. Basic research of mechanical systems of blades turning have started in the beginning of the last century and have been carried out up to now. Numerous scientific publications, aimed at analysis of statics, kinematics and dynamics of power regulation when using of centrifugal and aerodynamics mechanisms of blades turning, may be found in modern information sources [2; 3; 4; 5]. The first constructions of blades folding mechanisms (or so-called regulation mechanisms of “umbrella” type) may be found in literature of 50th-60th of the last century [6]. However, they have not widely extended since that time, although after the efficiency and actuation accuracy they do not yield to the mechanisms of blades turning [1]. In practice, fundamental investigations of blades folding mechanisms have not been carried out by neither domestic nor foreign scientists. The small amount of scientific publications, aimed at these investigations, confirms the presence of many unexplored problems. Some results of author’s investigations, concerned the rotation frequency stabilization of horizontal-axis wind turbines with the help of blades folding mechanisms, are presented in publications [7; 8].

From the analysis of modern information sources the following conclusion may be drawn: the majority of existent investigations and developments of power regulation mechanisms of “small” horizontal-axis wind turbines do not consider the opportunity of simultaneous combining of several regulation methods in one construction. At the same time, the necessity of developing of combined mechanical systems of blades turning and folding is caused by deficient regulation accuracy and operation reliability of each mechanism taken separately under the conditions of sudden (biting) and continuous changing of wind direction and intensity and in the gale-strength climatic conditions.

Formulating of article purpose. Analyzing of mechanical systems of power regulation and rotation frequency stabilization of horizontal-axis wind turbines, which function at the expense of blades turning and folding. Constructing of simplified kinematic diagrams of combined mechanisms of simultaneous blades turning and folding. Deducing of analytical dependencies for calculating of displacements of the sliders of corresponding mechanisms with the purpose of: further establishing the accordance of the mechanisms parameters to their preplanned operating conditions; determining of output parameters for further dynamic analysis (calculating of dynamic loads, kinetic energy, mechanical power etc.); solving such problems as synthesis and optimization of the mechanisms constructions.

Stating of basic results. Analytical methods are reasonably used for kinematic analysis of the mechanism under conditions in which its parts move according to some preplanned laws. These methods allow to put into practice multivariate investigations of mechanisms and to realize optimization synthesis of their constructions. A quantity of transactions concerned with analytical investigations of link mechanisms are published in modern technical literature. Among universal methods we may distinguish two basic types: 1) the method of vector lopped circuits introduced by V. A. Zinovyev; 2) the method of coordinates transformation developed by Yu. F. Moroshkin. The first method is more convenient for kinematic analysis of planar mechanisms, the second method is expedient for spatial mechanisms analysis. Classic mechanisms of blades turning and folding may be presented as planar or as spatial constructions. That’s why both mentioned methods of kinematic analysis may be used for their investigation. Combined mechanical systems of simultaneous blades turning and folding may be presented as spatial mechanisms only (fig. 1). That’s why the method of coordinates transformation will be used in further research.

Let’s consider simplified kinematic diagrams of mechanisms of blades turning and folding of horizontal-axis WT (fig. 1, a, b) [7; 8]. Blades are pivotally connected with rotor hub, which is rotating round horizontal axis. Blades turning into feather position is realized as a result of regulating slider H_1 movement along wind-wheel axis and changing of hinges C and K positions (fig. 1, a). The process of blades folding is realized by means of regulating slider H_2 movement along wind-wheel axis (fig. 1, b). This slider changes blades angular position relative to wind-wheel axis (rotor tapering or conicity) and WT blow-off area by changing positions of hinges N and E .The force of ram pressure is driving force for blades turning and folding in case of passive regulation. When using inertial regulator, the centrifugal force of regulation weights can be used by way of driving force also [7; 8].

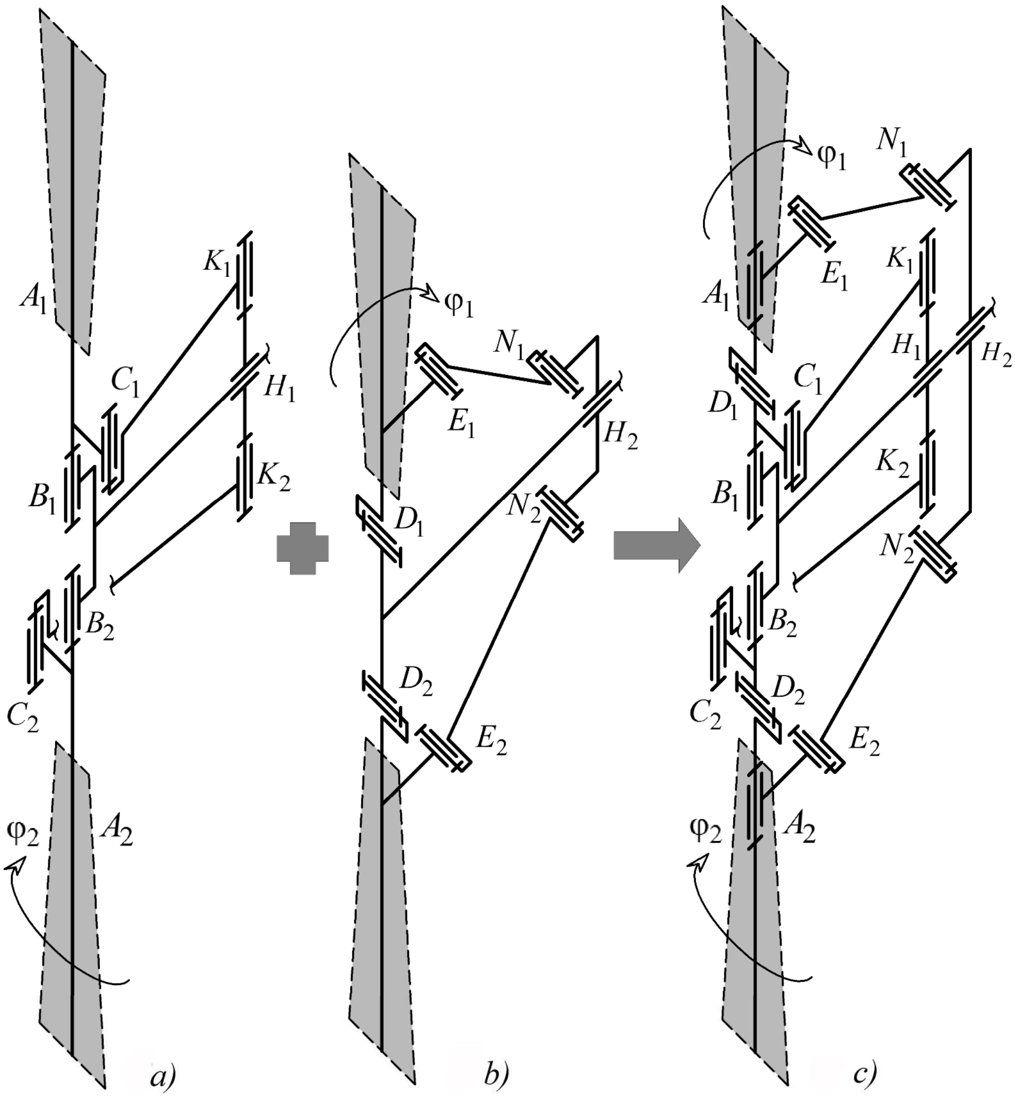

Fig. 1. Kinematic diagrams of blades turning mechanism (a), of blades folding mechanism (b) and of the combined mechanical system of blades simultaneous turning and folding (c)

Combined mechanical system of blades turning and folding (fig. 1, c) may be received by combining of the mechanism of blades folding (fig. 1, b) with the mechanism of blades turning round their own longitudinal axis (fig. 1, a). The presence of hinges B and D (fig. 1, c), which are placed on rotor hub, allows blades turning round two mutually perpendicular axes. Mentioned movements can be absolutely or conditionally independent, when sliders H_1 and H_2 are not joined or are connected by spring elements. Also these movements can be dependent, when sliders H_1 and H_2 are immovably joined. When sliders H_1 and H_2 are not joined or are joined by the spring the mechanical regulation system has two degrees of freedom. In such case the mechanisms of blades turning and folding may be investigated separately during the process of kinematic analysis. When sliders H_1 and H_2 are immovably joined the mechanical regulation system has one degree of freedom. Herewith the blades simultaneously turn round their own longitudinal axes and round the hinges of their attaching to the wind-wheel hub (fig. 1, c).

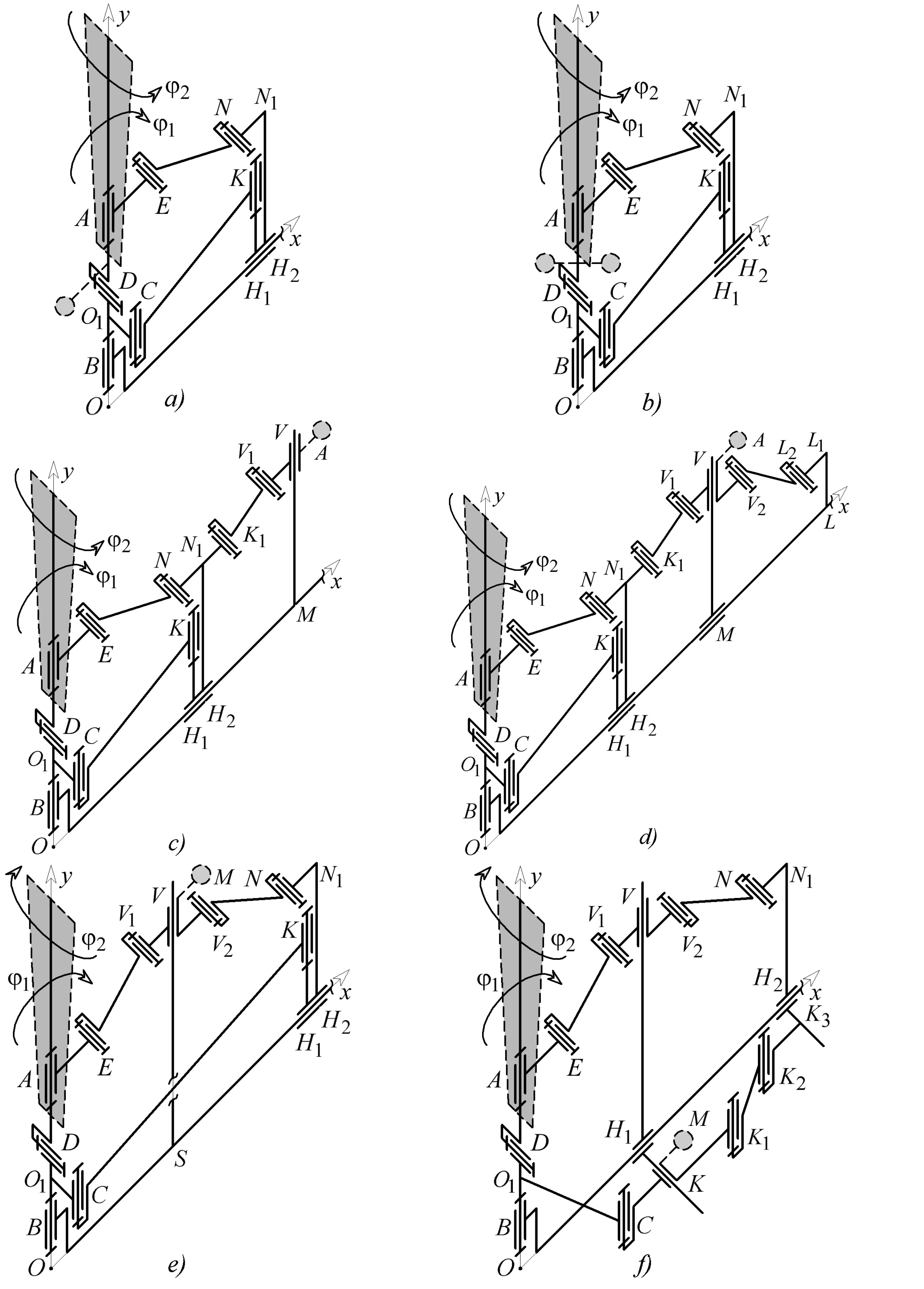

Fig. 2. Spatial kinematic diagrams of various types of combined mechanisms of blades turning and folding

In further investigations we will analyze combined mechanisms of blades turning and folding with one degree of freedom (fig. 2). At that the initial link (blade axis DA or blade cross-section (fig. 2)) of all mechanisms accomplishes rotary axis motion. That's why the corresponding angles φ_1 or φ_2 may be chosen as the generalized coordinate, which definitely determines the position of the rest parts of the mechanism. The position of the coordinates origin is placed in the point O, the abscissa axis is directed to the right along wind-wheel axis and the ordinate axis is directed vertically upwards. The dimensions of the units and the angles of their mutual bracing are the input data for kinematic analysis.

In all proposed diagrams of combined mechanisms of blades turning and folding (fig. 2) the angles of blade chord turning and blades axis deviation relatively to wind-wheel rotation plane are mutually related (interdependent). The dependences of the distance (along the abscissa axis) between the place of wind-wheel hub attachment (point O) and regulation sliders (H_1 and H_2) positions from the blades inclination (φ_1) and turning (φ_2) angles of the regulation mechanisms (fig. 2, a-d) may be presented as:

$$\begin{gathered}
x_{H_2} = l_{OD} \cdot \cos(\varphi_{OD}) + \sqrt{l_{DA}^2 + l_{AE}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos(\varphi_{AE})} \times \\
\times \sin\left(\arcsin\left(\frac{l_{AE} \cdot \sin(\varphi_{AE})}{\sqrt{l_{DA}^2 + l_{AE}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos(\varphi_{AE})}} \right) + \varphi_1 \right) + \\
+ \sqrt{ l_{EN}^2 - \left(\left[\begin{gathered} l_{OD} \cdot \sin(\varphi_{OD}) + \sqrt{l_{DA}^2 + l_{AE}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos(\varphi_{AE})} \times \\ \times \cos\left(\arcsin\left(\frac{l_{AE} \cdot \sin(\varphi_{AE})}{\sqrt{l_{DA}^2 + l_{AE}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos(\varphi_{AE})}} \right) + \varphi_1 \right) \end{gathered} \right] - \atop - l_{N_1H_2} \cdot \sin(\varphi_{N_1H_2}) \right)^2 } - \\
- l_{N_1H_2} \cdot \cos(\varphi_{N_1H_2}); \\
x_{H_1} = l_{O_1C} \cdot \sin(\varphi_2 + \varphi_{O_1C}) + \sqrt{l_{CK}^2 - \left(l_{O_1C} \cdot \cos(\varphi_2 + \varphi_{O_1C}) - l_{H_1K} \cdot \sin(\varphi_{H_1K}) \right)^2} - \\
- l_{H_1K} \cdot \cos(\varphi_{H_1K}) + l_{OO_1} \cdot \cos(\varphi_{OD}),
\end{gathered} \tag{1}$$

where x_{H_2}, x_{H_1} – the distances between the wind-wheel hub attachment and the sliders H_1 and H_2 correspondingly; l_{OD}, l_{DA}, l_{AE}, l_{EN}, $l_{N_1H_2}$, l_{O_1C}, l_{CK}, l_{H_1K}, l_{OO_1} – the lengths of the rods OD, DA, AE, EN, N_1H_2, O_1C, CK, H_1K, OO_1 correspondingly; φ_{OD}, φ_{AE}, $\varphi_{N_1H_2}$, φ_{H_1K} – the angles between the lines OD and OH_1, DA and AE, OH_1 and N_1H_2, OH_1 and H_1K correspondingly; φ_{O_1C} – the angle between the blade chord and the rod O_1C (fig. 2, a-d).

The dependences of the distance (along the abscissa axis) between the place of wind-wheel hub attachment (point O) and regulation sliders (H_1 and H_2) positions from the blades inclination (φ_1) and turning (φ_2) angles of the regulation mechanism (fig. 2, e) may be presented as:

$$\begin{gathered}
x_{H_2} = -l_{N_1H_2} \cdot \cos(\varphi_{N_1H_2}) + \frac{1}{\mathrm{tg}^2(\varphi_{SV}) + 1} \times \\
\times \left[\left(\begin{gathered} l_{OD} \cdot \cos(\varphi_{OD}) + \sqrt{l_{DA}^2 + l_{AE}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos(\varphi_{AE})} \cdot \sin(\varphi_{DE} + \varphi_1) + \\ + l_{OS} \cdot \mathrm{tg}^2(\varphi_{SV}) + \\ + \left(l_{OD} \cdot \sin(\varphi_{OD}) + \sqrt{l_{DA}^2 + l_{AE}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos(\varphi_{AE})} \cdot \cos(\varphi_{DE} + \varphi_1) \right) \cdot \mathrm{tg}(\varphi_{SV}) \end{gathered} \right) \pm \right.
\end{gathered} \tag{2}$$

$$\left.\pm\sqrt{\begin{aligned}&\left(l_{V_1E}\right)^2\cdot\left(\mathrm{tg}^2(\varphi_{SV})+1\right)-\left(\begin{gathered}l_{OS}\cdot\mathrm{tg}(\varphi_{SV})+l_{OD}\cdot\sin(\varphi_{OD})+\\+\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}\cdot\cos(\varphi_{DE}+\varphi_1)\end{gathered}\right)^2+\\&+\left(l_{OD}\cdot\cos(\varphi_{OD})+\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}\cdot\sin(\varphi_{DE}+\varphi_1)\right)\cdot\mathrm{tg}(\varphi_{SV})\times\\&\times\left(\begin{gathered}2\cdot\left(l_{OD}\cdot\sin(\varphi_{OD})+\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}\cdot\cos(\varphi_{DE}+\varphi_1)\right)+\\+2\cdot l_{OS}\cdot\mathrm{tg}(\varphi_{SV})-\\-\left(l_{OD}\cdot\cos(\varphi_{OD})+\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}\cdot\sin(\varphi_{DE}+\varphi_1)\right)\cdot\mathrm{tg}(\varphi_{SV})\end{gathered}\right)\end{aligned}}\;\right]+$$

$$+\sqrt{\left(l_{V_2N}\right)^2-\left(\begin{gathered}-l_{N_1H_2}\cdot\sin\left(\varphi_{N_1H_2}\right)+\frac{\mathrm{tg}(\varphi_{SV})}{\mathrm{tg}^2(\varphi_{SV})+1}\times\\\times\left[\begin{gathered}l_{OD}\cdot\cos(\varphi_{OD})-l_{OS}+\\+\sin(\varphi_{DE}+\varphi_1)\cdot\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}+\\+\mathrm{tg}(\varphi_{SV})\cdot\left(\begin{gathered}l_{OD}\cdot\sin(\varphi_{OD})+\\+\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}\cdot\cos(\varphi_{DE}+\varphi_1)\end{gathered}\right)\pm\\\pm\sqrt{\begin{gathered}\left(l_{V_1E}\right)^2\cdot\left(\mathrm{tg}^2(\varphi_{SV})+1\right)-\\-\left(\begin{gathered}l_{OS}\cdot\mathrm{tg}(\varphi_{SV})+l_{OD}\cdot\sin(\varphi_{OD})+\\+\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}\cdot\cos(\varphi_{DE}+\varphi_1)\end{gathered}\right)^2+\\+\left(\begin{gathered}l_{OD}\cdot\cos(\varphi_{OD})+\\+\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}\cdot\sin(\varphi_{DE}+\varphi_1)\end{gathered}\right)\cdot\mathrm{tg}(\varphi_{SV})\times\\\times\left(\begin{gathered}2\cdot\left(\begin{gathered}l_{OD}\cdot\sin(\varphi_{OD})+\\+\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}\cdot\cos(\varphi_{DE}+\varphi_1)\end{gathered}\right)+\\+2\cdot l_{OS}\cdot\mathrm{tg}(\varphi_{SV})-\\-\left(\begin{gathered}l_{OD}\cdot\cos(\varphi_{OD})+\sin(\varphi_{DE}+\varphi_1)\times\\\times\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}\end{gathered}\right)\cdot\mathrm{tg}(\varphi_{SV})\end{gathered}\right)\end{gathered}}\end{gathered}\right]\end{gathered}\right)^2}\;;$$

$$x_{H_1}=l_{O_1C}\cdot\sin\left(\varphi_2+\varphi_{O_1C}\right)+\sqrt{l_{CK}^2-\left(l_{O_1C}\cdot\cos\left(\varphi_2+\varphi_{O_1C}\right)-l_{H_1K}\cdot\sin(\varphi_{H_1K})\right)^2}-$$
$$-l_{H_1K}\cdot\cos(\varphi_{H_1K})+l_{OO_1}\cdot\cos(\varphi_{OD}),$$

where l_{OS}, l_{V_1E}, l_{V_2N} – the lengths of the rods OS, V_1E, V_2N correspondingly; φ_{SV} – the angle between the lines SV і OH_1; φ_{DE} – the angle between the line, traced across the centers of the hinges D, E and blades longitudinal axis (fig. 2, e). The angle φ_{DE} may be calculated from the dependence:

$$\varphi_{DE}=\arcsin\left(\frac{l_{AE}\cdot\sin(\varphi_{AE})}{\sqrt{l_{DA}^2+l_{AE}^2+2\cdot l_{DA}\cdot l_{AE}\cdot\cos(\varphi_{AE})}}\right).$$

The dependences of the distance (along the abscissa axis) between the place of wind-wheel hub attachment (point O) and regulation sliders (H_1 and H_2) positions from the blades turning (φ_2) angle of the regulation mechanism (fig. 2, f) may be presented as:

$$\begin{gathered}
x_{H_1} = l_{O_1C} \cdot \sin\left(\varphi_2 + \varphi_{O_1C}\right) - \frac{l_{O_1C} \cdot \cos\left(\varphi_2 + \varphi_{O_1C}\right)}{\operatorname{tg}\left(\varphi_{H_1K}\right)}; \\
x_{H_2} = l_{O_1C} \cdot \sin\left(\varphi_2 + \varphi_{O_1C}\right) + \sqrt{\left(l_{K_1K_2}\right)^2 - \left(l_{O_1C} \cdot \cos\left(\varphi_2 + \varphi_{O_1C}\right) - l_{H_2K_3} \cdot \sin\left(\varphi_{H_2K_3}\right)\right)^2} - \\
- l_{H_2K_3} \cdot \cos\left(\varphi_{H_2K_3}\right),
\end{gathered} \tag{3}$$

where $l_{K_1K_2}$, $l_{H_2K_3}$ – the lengths of the rods K_1K_2, H_2K_3 correspondingly; φ_{H_1K}, $\varphi_{H_2K_3}$ – the angles between the lines H_1K and OH_1, H_2K_3 and OH_1 correspondingly (fig. 2, f).

For determining the dependence of blades inclination angle φ_1 from the length values of the x_{H_1} and x_{H_2} the next formulas may be used:

$$\begin{gathered}
y_V = l_{N_1H_2} \cdot \sin\left(\varphi_{N_1H_2}\right) + \sqrt{l_{NV_2}^2 - \left(x_{H_2} - x_{H_1}\right)^2}; \\
x_{H_1} = l_{OD} \cdot \cos\left(\varphi_{OD}\right) + \sqrt{l_{DA}{}^2 + l_{AE}{}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos\left(\varphi_{AE}\right)} \cdot \sin\left(\varphi_{DE} + \varphi_1\right) + \\
+ \sqrt{l_{EV_1}^2 - \left(y_V - l_{OD} \cdot \sin\left(\varphi_{OD}\right) - \sqrt{l_{DA}{}^2 + l_{AE}{}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos\left(\varphi_{AE}\right)} \cdot \cos\left(\varphi_{DE} + \varphi_1\right)\right)^2} = \\
= l_{OD} \cdot \cos\left(\varphi_{OD}\right) + \sqrt{l_{DA}{}^2 + l_{AE}{}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos\left(\varphi_{AE}\right)} \cdot \sin\left(\varphi_{DE} + \varphi_1\right) + \\
+ \sqrt{l_{EV_1}^2 - \left(\begin{gathered} l_{N_1H_2} \cdot \sin\left(\varphi_{N_1H_2}\right) + \\ + \sqrt{l_{NV_2}^2 - \left(\begin{gathered} \left(\begin{gathered} l_{O_1C} \cdot \sin\left(\varphi_2 + \varphi_{O_1C}\right) - l_{H_2K_3} \cdot \cos\left(\varphi_{H_2K_3}\right) + \\ + \sqrt{\left(l_{K_1K_2}\right)^2 - \left(\begin{gathered} l_{O_1C} \cdot \cos\left(\varphi_2 + \varphi_{O_1C}\right) - \\ - l_{H_2K_3} \cdot \sin\left(\varphi_{H_2K_3}\right) \end{gathered}\right)^2} \end{gathered}\right) - \\ - \left(l_{O_1C} \cdot \sin\left(\varphi_2 + \varphi_{O_1C}\right) - \frac{l_{O_1C} \cdot \cos\left(\varphi_2 + \varphi_{O_1C}\right)}{\operatorname{tg}\left(\varphi_{H_1K}\right)}\right) \end{gathered}\right)^2} - \\ - l_{OD} \cdot \sin\left(\varphi_{OD}\right) - \sqrt{l_{DA}{}^2 + l_{AE}{}^2 + 2 \cdot l_{DA} \cdot l_{AE} \cdot \cos\left(\varphi_{AE}\right)} \cdot \cos\left(\varphi_{DE} + \varphi_1\right) \end{gathered}\right)^2},
\end{gathered} \tag{4}$$

where y_V – the ordinate (y-coordinate) of the slider V (fig. 2, f).

It should be noticed, that the lengths of the rods l_{NN_1}, $l_{L_1L_2}$, l_{VV_1}, l_{VV_2}, $l_{N_1K_1}$, l_{KK_1}, l_{KC}, $l_{K_2K_3}$ equal zero in all presented calculations.

With the help of the equations systems (1), (2), (3) i (4) the dependence between the blades turning and folding angles may be calculated, when the distance between the sliders H_1 and H_2 is known and the geometrical parameters of separate elements of regulation mechanisms are prefixed. Analytical solutions of these equations systems are too bulky. That's why the solutions are not presented in this article.

For adequacy confirmation of deduced analytical dependences the computation models of corresponding mechanisms (fig. 2) were designed in the physical modeling and simulation tool MapleSoft MapleSim 6.4 (fig. 3). Based on these models the analysis of influence of various geometrical parameters on displacements of sliders and centrifugal weights will be carried out in further investigations.

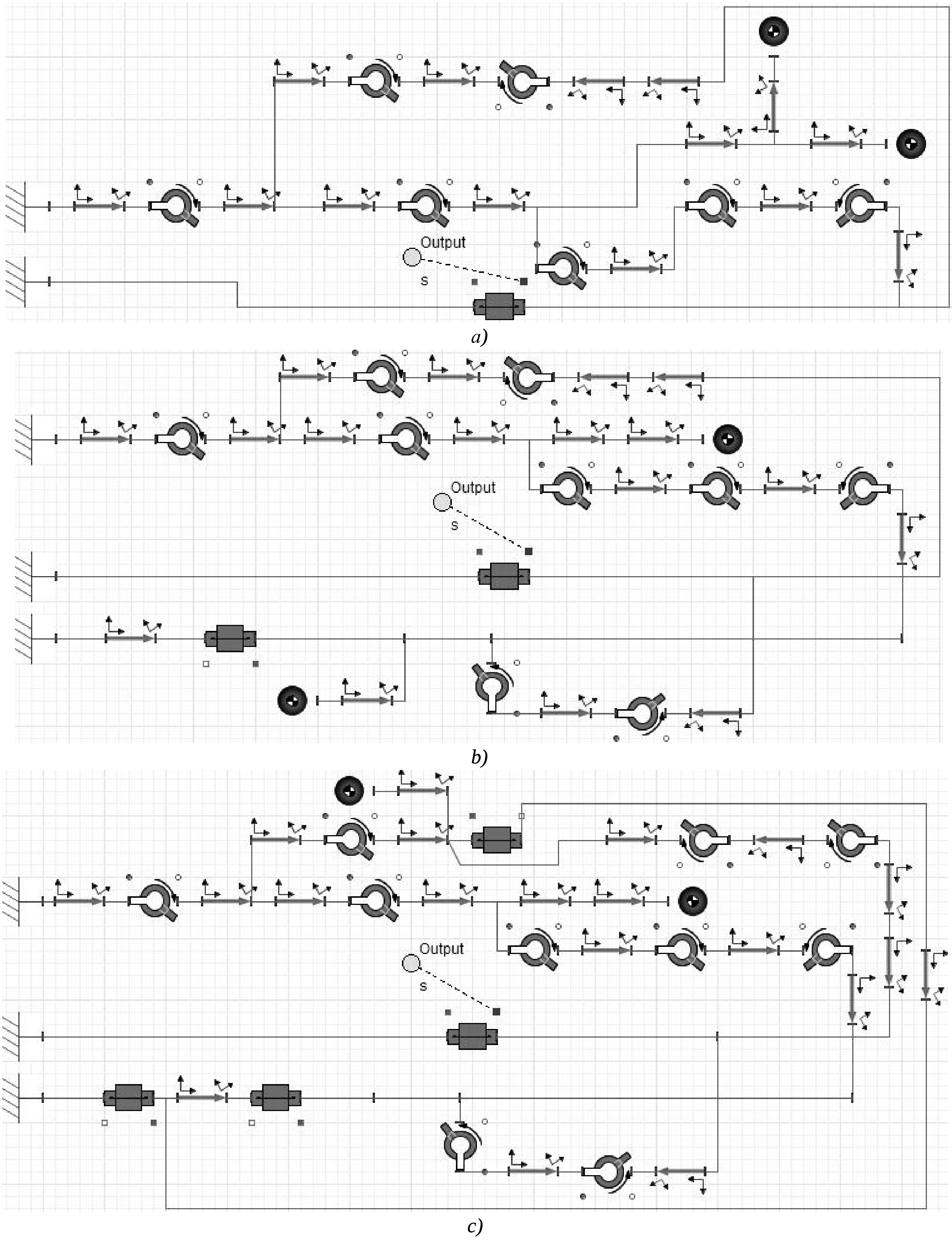

Fig. 3. Computation models of the mechanisms of blades turning and folding designed in MapleSoft MapleSim 6.4: a – for mechanisms presented at fig. 2, a-d; b – for mechanism presented at fig. 2, e; c – for mechanism presented at fig. 2, f;

Conclusions. In presented investigations the necessity of further improvement of mechanical regulation systems of horizontal-axis wind turbines of small power is substantiated; various principle schemes of combined mechanisms of simultaneous blades turning and folding are considered; analytical expressions for determining the dependencies of regulation sliders displacements from the blades turning and inclination angles are deduced; computation models of corresponding mechanisms are designed in the physical modeling and simulation tool MapleSoft MapleSim 6.4; prospects of further investigations, which consists in carrying out the dynamic analysis (calculating of dynamic loads, kinetic energy, mechanical power etc.) and solving such problems as synthesis and optimizations of regulation mechanisms constructions, are proposed. Also on the basis of presented investigations the analysis of influence of various geometrical parameters of regulation mechanisms on displacements of sliders and centrifugal weights may be carried out in further research with the purpose of minimization of the first and maximization of the second displacement value.

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