The methods of analysis of field research and data to compare characteristics of the new shelves plow with existing.

Plow, power characteristics, the resistance of the soil.

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ON TURN drag coefficient Tracked vehicles

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Dependence of the coefficient resistance to rotation of tracked vehicle turning radius, which is implemented in the new model of interaction Caterpillar tracks the supporting surface. The model provides a satisfactory accuracy of the calculated data over the entire range of possible turning radius tracked vehicles.

Tracked vehicles, the rate of resistance to rotation, turning radius.

Problem. Turn tracked vehicles, due to design features, always accompanied by Prosecutor-vzuvannyam its drivers. Therefore, the main task is to calculate the curvilinear motion since the resistance to rotation M_c That defines Mane vrenist, manageability and energy machines. As the comparison of machines with different mass-overall performance is possible only on specific indicators, over the last coefficients resistance to rotation μ Which is a specific moment resistance to rotation:

$$\mu = 4M_c/(GL), \quad (1)$$

where G and L - Under the weight of the machine and its longitudinal base.

Coefficient of resistance to rotation μ essentially depends on the radius of turn machines, but empirical formula for calculating μ Proposed AO Nikitin, does not reflect the physical nature of this relationship [1]. In this regard, currently focuses on the description of the analytical engine force interaction with the soil, which can be divided into two main areas:

• School MI Medvedev, who laid the basis for models mentioned interaction separate records resistance to rotation, friction bearing surface units and spurs with the ground, crushing and shearing the lateral surface of the ground track, nahribannya earthworks and additional friction in machinery tracked system. Representatives of this school diagrams specified pressure on the ground, described the movement in slope, take into account the impact of hook load, distortion and slipping tracks [2; 3] and so on. Paying due attention to the deformation properties of the soil, they are, however, ignored the relationship of longitudinal and transverse components of the forces in contact with drivers support limiting the scope of the model of medium and large turning radius;

• School FO Opeyka, which laid the basis for models of the forces of friction tracks the supporting surface and described them based on the laws of mechanics friction. His followers specified model [4; 5; 6], etc., but the lack of consideration of elastic properties in contact limited scope of these models minimum turning radius.

Thus assumptions adopted in the preparation of the existing models of interaction with drivers supporting surface, do not allow them to use the entire range of possible radii.

Analysis of recent research and publications. Known also considered a new model of interaction [7], based on the approach FO Opeyka considering deformation properties of the soil. However, the adequacy of the model in terms of functional dependence of μ on the radius of rotation (in the whole range of its possible values) were determined.

The purpose of the study. Assess the adequacy of the proposed model caterpillars force interaction with the soil in terms of functional dependence of resistance to rotation of the μ-range static turning machines (in which the forces of inertia can be neglected) over the entire range of possible values of the latter.

Results. According to the procedure described in [7], the number of unknown quantities for dvohusenychnoyi machines ($n = 2$) is equal to $2n + 2 = 2 \times 2 + 2 = 6$, namely:

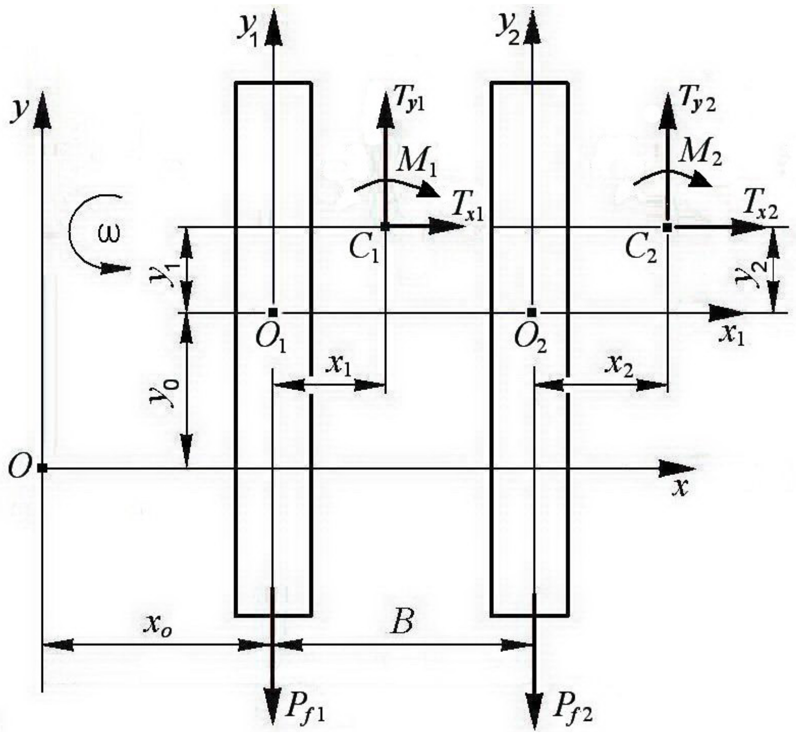

Fig. 1. The power circuit static turning tracked vehicle (index 1 - caterpillar lagging index 2 - Running track):

• four coordinates (x_1, y_1, x_2, y_2) Instant centers sliding tracks C1 and C2 (Fig. 1);

• two unknown coordinates of the center of rotation O1 behind tracks (x0 y0 and) in the overall system of coordinates.

The model contains the necessary static turning six equations [7] balance:

$$T_{x1} + T_{x2} = 0, \qquad (2)$$

$$T_{y_1} + T_{y_2} - P_{f1} - P_{f2} = 0, \qquad (3)$$

$$T_{y1}(x_0 + x_1) - T_{y2}(x_0 + B + x_2) - T_{x1}(y_0 + y_1) +$$
$$+ M_2 + P_{f2}(x_0 + B) - T_{x2}(y_0 + y_2) + P_{f1}x_0 + M_1 = 0, \quad (4)$$

where P_{f1} and P_{f2} - The resistance movement behind and running tracks, each of which (forces) is equal to half the product of the weight of the machine by a factor G resistance movement f;

• two equations of geometric relationships:

$$y_1 + y_0 = 0, \qquad (5)$$

$$y_2 + y_0 = 0; \qquad (6)$$

• one equation kinematic connection (one of three possible depending on the mode of movement):

• • $T_{y1} = 0$ - When disconnected behind tracks; (7, a)

• • $x_0 + x_1 = 0$ - When inhibited caterpillars; (7 b)

• • $(x_0 + x_1)k = x_0 + B + x_2$ - At a known velocity ratio k and running tracks behind where $k = V_2 / V_1$.   (7 in)

According to FO Opeyko power factors $T_{x1}, T_{y1}, M_1, T_{x2}, T_{y2}, M_2$ are functions of unknown coordinates x_1, y_1, x_2, y_2 instantaneous center of rotation. Failure wide tracks gives an error less than 2% [3], which allows to reduce to one-dimensional integrals of functions:

$$T_{x1} = -\frac{G}{2Lb} \int_{-L/2}^{L/2} \varphi_x \frac{y_1 - \eta}{\sqrt{x_1^2 + (y_1 - \eta)^2}} d\eta; \quad (8)$$

$$T_{x2} = -\frac{G}{2Lb} \int_{-L/2}^{L/2} \varphi_x \frac{y_2 - \eta}{\sqrt{x_2^2 + (y_2 - \eta)^2}} d\eta; \quad (9)$$

$$T_{y1} = -\frac{G}{2Lb} \int_{-L/2}^{L/2} \varphi_y \frac{x_1}{\sqrt{x_1^2 + (y_1 - \eta)^2}} d\eta; \quad (10)$$

$$T_{y2} = -\frac{G}{2Lb} \int_{-L/2}^{L/2} \varphi_y \frac{x_2}{\sqrt{x_2^2 + (y_2 - \eta)^2}} d\eta; \quad (11)$$

$$M_1 = \frac{G}{2Lb} \int_{-L/2}^{L/2} \frac{\varphi_x (y_1 - \eta)^2 + \varphi_y x_1^2}{\sqrt{x_1^2 + (y_1 - \eta)^2}} d\eta; \quad (12)$$

$$M_2 = \frac{G}{2Lb} \int_{-L/2}^{L/2} \frac{\varphi_x (y_2 - \eta)^2 + \varphi_y x_2^2}{\sqrt{x_2^2 + (y_2 - \eta)^2}} d\eta. \quad (13)$$

where L, b - Longitudinal base width and tracks;

η - Longitudinal coordinate basic plot tracks;

$\varphi_õ$ and $\varphi_ó$ - Respectively the longitudinal and transverse components of the coupling coefficient φ basic plot tracks the supporting surface, provided that a given coefficient is a function of the value of sliding k_δ the said plot - Fig. 2.

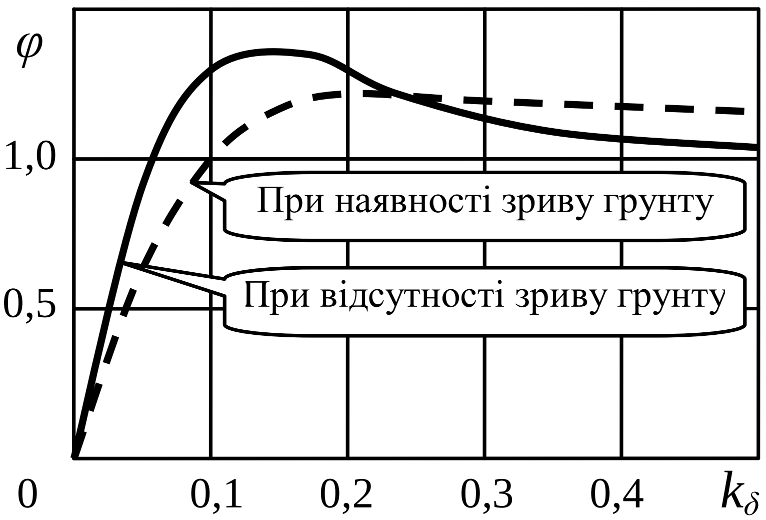

Fig. 2. Dependence of the coupling φ the value of slip k_δ.

Value sliding unit area tracks with coordinate η can be expressed in terms listed previously unknown size $\tilde{o}_i$ and $\acute{o}_i$:

$$k_{\delta 1} = \frac{\sqrt{\tilde{o}_1^2 + (\acute{o}_1 - \eta)^2}}{\tilde{o}_0 + \tilde{o}_1}, k_{\delta 2} = \frac{\sqrt{\tilde{o}_2^2 + (\acute{o}_2 - \eta)^2}}{\tilde{o}_0 + \hat{A} + \tilde{o}_2}. \quad (14)$$

Taking into account the elastic properties of the soil by means of the above variables coupling coefficients $\varphi_{\tilde{o}}$ and $\varphi_{\acute{o}}$. Their value is calculated using the formula V. Katsyhina [8], which makes it easy to take into account the lack of soil disruption in the lateral direction ($\chi_{\delta x} = 0$), Retaining its consideration along tracks ($\chi_{\delta y} \neq 0$):

$$\varphi_{\tilde{o}} = \varphi_{\delta\tilde{o}} th(k_\delta / \lambda_\delta); \qquad \varphi_{\acute{o}} = \varphi_{\delta\acute{o}} \left(1 + \frac{\chi_\delta}{ch(k_\delta / \lambda_\delta)}\right) th(k_\delta / \lambda_\delta), \quad (15)$$

where - $\varphi_{\delta\tilde{o}}$ = 1.183, $\varphi_{\delta\tilde{o}}$ = 1.259 - friction coefficient on plowed field in full accordance sliding in the transverse and longitudinal directions;

λ_δ = 0.1; χ_δ = 0.7 - empirical coefficients caterpillars interaction with the soil. Their values obtained in [7] by additional processing experimental data [3].

As a result of numerical solution of equations (2 - 7), made on the basis of relations (8 - 15), by unknown coordinates $\tilde{o}_0$, $\acute{o}_0$, $\tilde{o}_1$, $\acute{o}_1$, $\tilde{o}_2$, $\acute{o}_2$ and turn the main characteristics:

- turning radius $R = \tilde{o}_0 + 0{,}5\hat{A}$;
- Looking longitudinal force ($T_{\acute{o}2}$) And behind ($T_{\acute{o}1}$) Caterpillars;
- moment of resistance turning machines: $M_{\text{c}} = 0{,}5B(T_{y1} - T_{y2})$;
- the resistance to rotation machines (the formula (1)).

Fig. 3-5 conducted to compare the new model for the functional dependence of resistance to rotation μ (R) with known dependencies by model school FO Opeyka and school M.I.Medvedeva - B.M.Pozina.

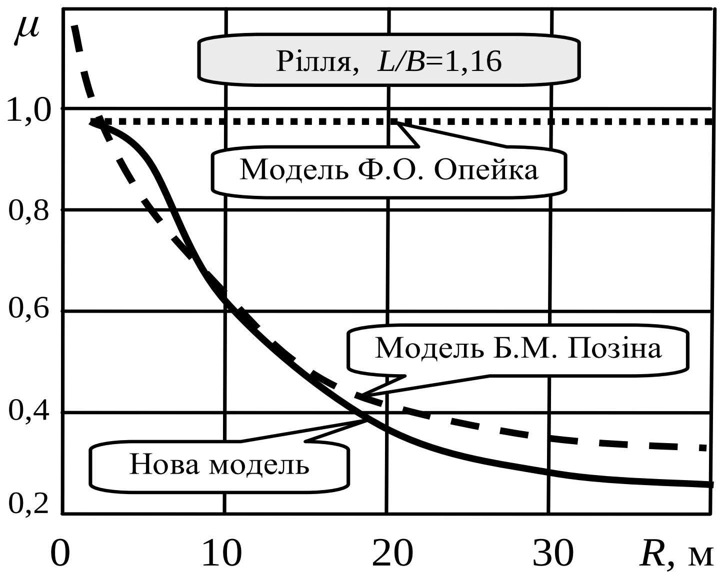

Fig. 3. Functional dependence $\mu(R)$ for tracked vehicles with relative length tracks L / B = 1,16 while driving on arable land.

They show that the results obtained with the new model, can describe the rotation of tracked vehicles over the entire range of possible radii. With minimal radius (turn around inhibited board) results are consistent with the model FO Opeyka. In medium and large turning radius (over 10m) New model satisfactorily data are consistent with the model BM Posina.

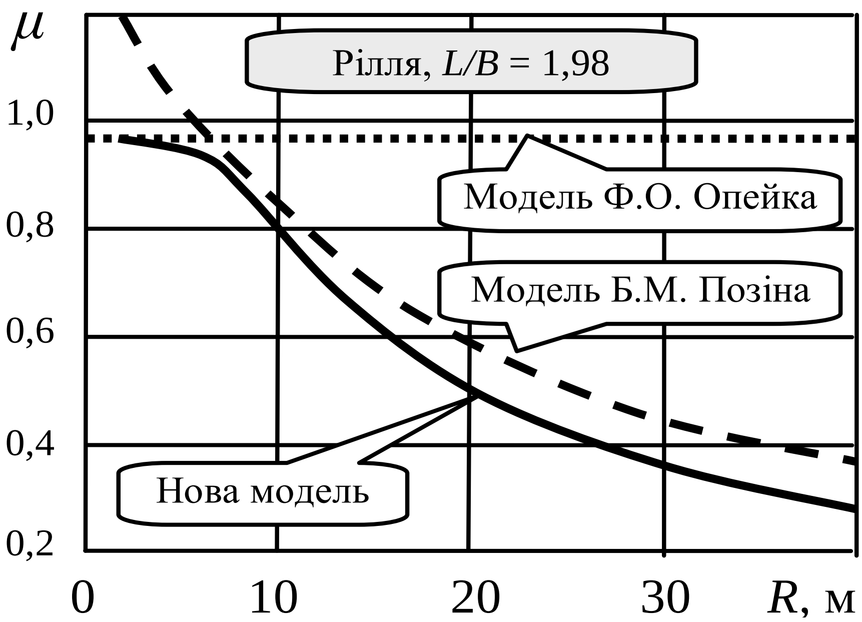

Fig. 4. Functional dependence $\mu(R)$ for tracked vehicles with relative length tracks L / B = 1,98 while driving on arable land.

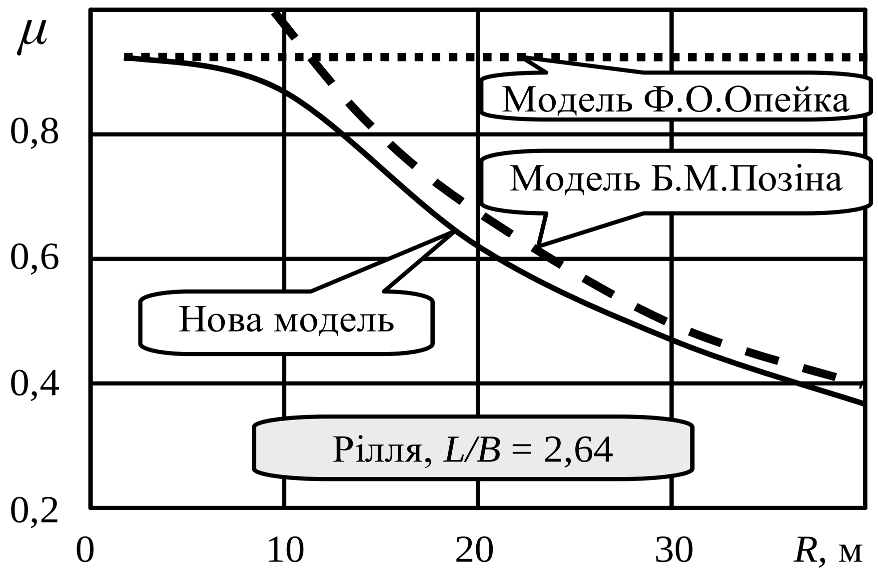

Fig. 5. Functional dependence $\mu(R)$ for tracked vehicles with relative length tracks L / B = 2,64 while driving on arable land.

Analysis of the relationship $\mu(R)$ also showed that the ratio L / B significantly affect the nature of the curve - Fig. 6.

For large and medium turning radius functional dependence L / B vary considerably, reflecting the impact of structural parameters resisting rotation. However, at small radii (turn around completely or almost completely shutdown caterpillars) all curves tend to value φ_{max} Bounded grip on this type of soil.

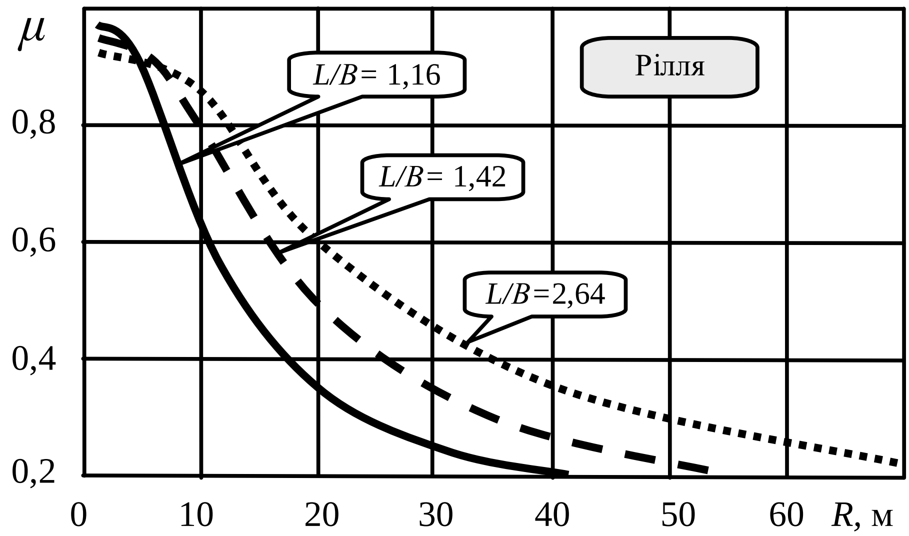

Fig. 6. Coefficient of resistance to rotation μ three machines with different relative lengths of tracks L / B.

Conclusion. Dependence of the μ the radius of turn, implemented a new model of interaction caterpillar mover to the supporting surface, providing satisfactory calculation accuracy over the entire range of possible radii.

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Rassmotrena dependence Resistance Factor husenychnoy mashiny from turning radius turns, kotoraja realyzuetsya a new model of interaction tracked dvyzhyteley with opornoy poverhnostyu. ÎÍÀ obespechyvaet udovletvorytelnuyu accuracy of data raschetnыh t vsem bands vozmozhnыh radyusov turns husenychnoy machine.

Husenychnaya machine Resistance Factor rotation, radius turns.

Dependence of the coefficient of resistance to a caterpillar machine turn on the radius of this turn realized in a new model of interaction of caterpillar movers with the support surface is reviewed in this article. This model gives satisfactory accuracy of calculated data in the full range of possible radii of turns of a caterpillar machine.

Caterpillar machine, coefficient of resistance to turn, turn radius

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