DYNAMIC RADIUS WHEELS IN THE LIGHT OF THE LAW ENERGY SAVING

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In the theory of elastic rolling wheels there is no consensus as to what range should be used in determining the performance of the power wheels - dynamic or rolling radius. This paper shows that the use of the dynamic range is contrary to the law of conservation of energy. This is evidence of impropriety use of dynamic range.

Elastic wheel, dynamic range, rolling radius.

Problem. At present there is no clear opinion on what radius should be used in determining the performance of flexible power wheels - dynamic $r_д$, Understood as the distance from the reference plane to the center of the wheel, moving or rolling radius $r_к$, Understood as the ratio

the longitudinal component of the velocity of the wheel V (Without slipping or slipping) and its angular velocity ω (Or, equivalently, as the ratio of longitudinal component growth path δL to increase the angle of rotation of the wheel $\delta\alpha$):

$$r_к = \frac{V}{\omega} \equiv \frac{\delta L}{\delta\alpha}. \tag{1}$$

For example, to determine the relationship between torque wheels $M_к$ and its pulling force $P_к$ view diagram of forces and moments applied to the drive wheels in case of uniform motion - Fig. 1.

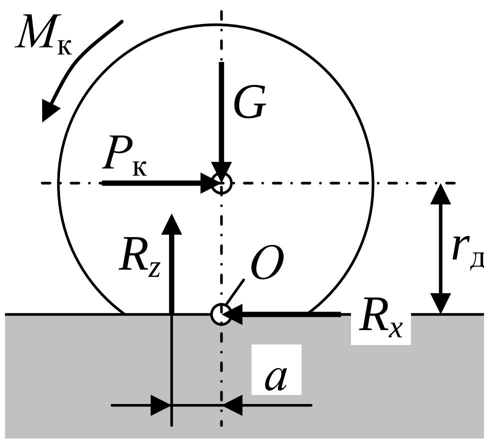

Fig. 1. The wheel assembly equilibrium equation under the applied thereto forces and moments.

The equation of equilibrium of the wheels relative to t. O is:

$$\Sigma M_O = M_к - P_к \cdot r_д - R_z \cdot a = 0\,, \qquad (2)$$

where R_z - Normal reaction bearing surface;

a - Longitudinal demolition normal reaction supporting surface.

Writing equation (2) as get that measure inter-mozv'yazku torque between the wheels and its pulling force is dynamic radius of the wheel $r_д$. Its also used in the textbook [1, p. 54], etc., not to mention the existence of other indicators.

$$M_к = P_к \cdot r_д + R_z \cdot a\,, \qquad (3)$$

Namely, the same relationship can install and use the equation for virtual work, which for the wheel shown in Fig. 2, is:

$$\delta A = M_к \cdot \delta\alpha - P_к \cdot \delta L - R_z \cdot a \cdot \delta\alpha = 0\,, \qquad (4)$$

where δL - A variation of the angular coordinates wheel;

$\delta\alpha$ - Variation of linear coordinates associated with variation δL ratio $\delta L / \delta\alpha = r_к$ Which follows from the definition of rolling radius of the wheel.

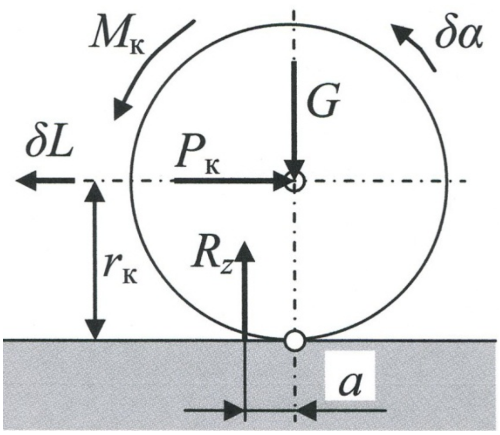

Fig. 2. Before drawing up the equation for virtual work.

Equation (4) implies ratio

$$M_к = P_к \cdot \frac{\delta L}{\delta\alpha} + R_z \cdot a = P_к \cdot r_к + R_z \cdot a\,. \qquad (5)$$

Ingredient $R_z \cdot a$ - This time rolling resistance tires M_f Which can be represented as the product of the normal reaction bearing surface R_z on the rolling resistance coefficient f and the radius of the wheel rolling $r_к$ ($M_f = R_z \cdot f \cdot r_{ê}$), So that the relation (5) can be written in the form:

$$M_к = P_к \cdot r_к + R_z \cdot f \cdot r_к\,. \qquad (6)$$

Expression (5) shows that the relationship between the index wheel torque and thrust his strength is not dynamic range, and the radius of the wheel bearings. Its also used in the textbook [2, p. 28], etc., not to mention the possibility of using the dynamic range.

A similar situation and foreign literature. In some cases the relationship under discussion is set with the radius rolling (rolling radius) [3, p. 410], and others - using dynamic-range (loaded radius) radius or no emphasis on its nature [3, p. 26].

However, the importance of dynamic range and radius rolling in some cases may differ by 15 ... 25% [4, p. 13]. This leads to a contradiction equations (3) and (5), kompromentuye theory of elastic rolling wheels. How can we believe the estimates, unless there is a clear consensus on the use of even radii wheels - the simplest and most fundamental concepts of the theory of rolling? Any calculation results of wheel drivers can doubt, contrasting them with other results.

The described discrepancy noticed another car theory founder Acad. Ye.O.Chudakov [5, p. 19, 32]. To fix it, he equated the right of the expressions (3) and (6), which was the formula for the coefficient of rolling resistance f as a function of values $r_д$ and $r_к$ [5, p. 31]. Its substitution in expression (6) gives a value identical expressions (3) and (6). However, this solution does not stand up to check the boundary condition, which is that any proper construction should give correct results in conditions where the input variables are close to the extreme values acceptable to them. In this case, assuming that the value of a and f tend to zero, the expressions (3) and (6) we obtain two different equations that can not give the same result. This indicates the artificiality of the decision.

Analysis of recent research. The author of [6] On the basis of his experimental studies suggested that the relationship between the applied torque to the wheel and its pulling force is determined by certain radius β (which he called a "factor") equal to the arithmetic mean free-range and static range $r_{ñò}$Where $r_{ñò} \approx r_{ä}$. But such a conclusion should be considered too artificial, as theory suggests only two alternative solutions - $r_д$ or $r_к$.

The results of other experimental studies that determined the numerical values of "force" radius and radius rolling tires idling in the table. Values marked with an asterisk obtained as a result of the author mathematical treatment of the data presented in Fig. 1 b and 1 in [8].

1. Rolling Radius $r_{к.х}$ (Idling) and "force" radius ρ Some tires.

Designation of tires and source of information	Radius Rolling $r_{к.х}$ City	"Power" radius ρ City	Deviation value ρ from $r_{к.х}$ %
480 / 70R34 [7]	.750	.770	2.7
GS-1 [8]	.677	.652	- 3.7
49h23,5-21LT NC2 AVTOROS [8]	0,600 *	0.634 *	5.7
49h23,5-21LT NC4 AVTOROS [8]	0.568 *	0.603 *	6.2

	.557	.569	2.2
600 / 50R22,5 modes. DT-46 [9]	.556	.579	4.1
	.556	.609	9.5
Mean deviation			3.8

The table shows that the value of "force" radius in six of seven cases received more than rolling radius. Since the dynamic range is always smaller than the radius of the rolling (determined without regard to slipping or sliding), it can be argued that the experimental data confirms the correctness of equations (5) and not (3).

However, experimental validation of equation (5) is not indicative of the error equation (3). For solving the dilemma "$r_д$ or $r_к$? "Also need to provide convincing proof of the falsity of the latter.

The aim - to clarify the theory of elastic wheels rolling by proving the falsity of (3).

Results. Equation (5) obtained from the equation of virtual wheels, subject to the law of conservation of energy. The latter is one of the most fundamental laws of nature and therefore "... provides a number of fairly general conclusions about the material properties of various mechanical processes, without delving into their detailed examination using the equations of motion" [10, p. 63].

Equation (3) resulting in a different way and contrary to equation (5). This means that it is contrary to the law of conservation of energy. As to date has not found any phenomenon, where the law was violated, then, if a process "... contrary to the law of conservation at once be said that this process is impossible and pointless to try to make it" [10, p. 63].

Thus the contradiction between the law of conservation of energy and equation (3) is sufficient evidence of falsity of the latter.

This means that, despite the "apparent correctness" of equation (3), it is false, that is, the interaction strength elastic wheels to the supporting surface is on the shoulder, which is not equal to the dynamic radius. This is the reason for the contradiction between the false equation (3) and right rivnyannnyam (5).

It also underscores the complexity of the interaction of elastic wheels to the supporting surface even in the simplest case that can not be correctly described using "obviously correct" equation (3). Search reason that supposedly correct scheme applied to the wheel forces and moments shown in Fig. 1 leads to a false equation (3) represents an interesting scientific problem for future work in the theory of rolling.

To its credit, the current standard compilers [11] It should be noted that allegations of inapplicability dynamic range to describe the elastic force corresponding to its wheels (standard) spirit and letter. There the term "dynamic range" located in the "center coordinates wheels ...", but not in the sections relating to the operation of the wheel.

Conclusion. The contradiction between the two known equations describing the relationship between elastic attached to the wheel (in the plane of rotation) forces and torque due to a misconception that the interaction strength of said wheel with the supporting surface is on the shoulder of the dynamic range. In fact it is on the shoulders of equal radius rolling, so that there is only one correct equation - namely, that based on the rolling radius.

References

1. GM Kutkov Traktorы and cars. Theory and Technological properties. - M .: ears, 2004. - 504 p.
2. Smirnov GA Motion Theory kolesnыh machines. - M .: Mashinostroenie, 1981. - 271 p.
3. Thomas D. Gillespie. Fundamentals of Vehicle Dynamics. - Warrendale: Society of Automotive Engineers. - 1992. - 470 p.
4. Petrushov VA*Shuklyn SA, Moskovkyn V.* Resistance rolling cars and avtopoezdov. - M .: Mashinostroenie, 1975. - 225 p.
5. EA Chudakov Theory car. - M .: Mashhyz, 1950. - 343 p.
6. Stankevich Э.В. Dependence of the power nahruzhenyya wheels from ego heometrycheskyh parameters. // Mechanization and эlektryfykatsyya agricultural sector. - 1987. - № 9. - P. 6-9.
7.*Goncharenko SV Z.A.Hodzhaev ZA, Э.В.StankevychЭ.В.* [Et al.]. Identification tires on эkspluatatsyonnым indicators // Traktorы and selskohozyaystvennые machine. - 2007. - № 7. - S. 16-19.
8. Zaitsev SD,*Goncharenko SV L.S.Streblechenko LS* [Et al.], Pull-stsepnые qualities vысokoэlastychnыh tire pressure sverhnyzkoho // Traktorы and selskohozyaystvennые machine. - 2008. - № 9. - P. 29-31.
9. Zaitsev SD,*Streblechenko LS, SV Goncharenko*. [Et al.] Experimental evaluation of Pull-stsepnыh qualities shyrokoprofylnoy bus // Traktorы and selhozmashynы. - 2010. - № 8. - P. 25-27.
10. Yrodov IE Basic Laws of mechanics. - M .: Higher School, 1978. - 240 p.
GOST 17697-72 11. Car.Rolling wheels. Termynы and definitions. - Enter. 06.05.1972. - M .: Izd standartov, 1972. - 24 p.

In theory эlastychnoho rolling wheels absent opinion about A edynoe of some kind radius sleduet Apply at work indicators for determining power wheels - Dynamic rolling radius Or. In dannoy the work shows something Application Dynamic radius contrary to law Saving energy. This is javljaetsja Proof of application nekorrektnosty Dynamic radius.

Эlastychnoe wheel, Dynamic radius, radius rolling.

There is absent a common opinion in the theory of rolling motion of an elastic wheel to the effect what radius should be used when assessing force characteristics - loaded or rolling radius. This paper shows that the application of the loaded radius contradicts the energy conservation law. This is a proof of incorrectness of use of loaded radius.

Elastic wheel, loaded radius, rollingradius.