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Theoretical Study of the Vertical Oscillation of the Combined Roller During Operation

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Abstract: The article presents the results of theoretical research on the development of a combined roller structure and the study of its vibrational motion in the vertical direction. It has been studied that an oscillating system with equal degrees of freedom oscillates in a vertical direction under the influence of a driving force. As a result of the research, a differential equation representing the vertical oscillations of the system was obtained. There is also a formula that represents the elasticity of prujinanitng, which is most commonly used in agricultural machinery.

Keywords: Roller, soil, compaction, deformation, spring, oscillating system, interaction, motion, elasticity, parameter, differential equation.

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Introduction

In the cultivation of agricultural crops, including small-seeded crops, special attention should be paid to compaction of the soil, leveling the surface of the buds. The required amount of soil density and the flatness of the pile surface allow for good water, air and heat regimes, sowing the seeds to the same depth, and allowing the seeds to interact with the soil.

In planting machines, rollers are usually used to compact the soil or to level the pile surface. Depending on the shape of the working surface, the rollers can be smooth, cylindrical, annular, star-shaped, ponasi-shaped, conical, and so on. will be. Depending on its function, it can be flattening, compacting, smoothing, smoothing the surface and universal [1].

As a result of the research, the construction of a combined roller used for row sowing of onion seeds was developed (Fig. 1). The combined roller consists of a stepped shaft 1 rotating about its axis, a truncated conical disc 2 and 3 compacting the side walls of the ridge, two ends 4 and 5 compacting the upper part of the ridge, and three intermediate 6, 7 and 8 elastic rubber cylindrical rings. , consists of 9, 10, 11 and 12 ponasi rings that open narrow ditches for sowing seeds. Ponasimon ring 9, 10, 11 and 12 have a knife-shaped tip 13 that opens narrow grooves for seeds and grooves 14 that form small peaks on the surface of the bud to bury the soil deformed from the narrow grooves after sowing the seeds. For fixed mounting of the working parts of the combined roller, on one side of the shaft 1 there is a step 15 larger than the inner diameter of the cut conical discs 2 and 3, and on the other side the thread is opened and they are tightened by means of a spring washer 16 and nut 17.

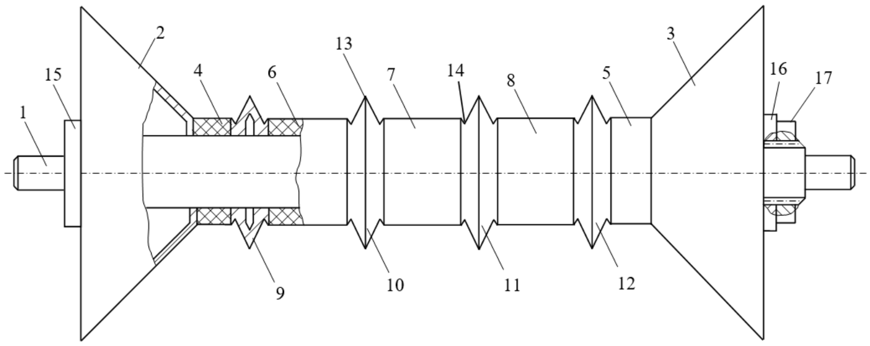


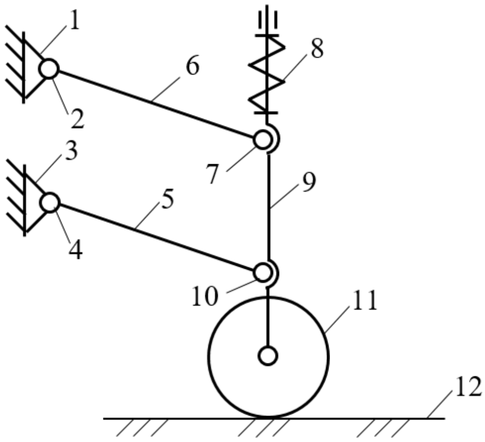
Figure 1. Combined reel

The combined roller works in the following order: during operation, the cut conical discs mounted on the shaft 1 rotate 2 and 3, compacting the side walls of the ridge to give a trapezoidal shape to the ridge and forming irrigation ridges at the required depth. At the same time the flexible rubber cylindrical ring 4, 5, 6, 7 and 8 compacts and flattens the upper part of the pile, the ponasal ring 9, 10, 11 and 12 crushes the existing lumps at the top of the pile using the knife tip 13 and narrow grooves for seeds. opens. Deformation of the soil from the opened narrow ditches creates small peaks on the surface of the ridge to bury the seeds sown using the grooves 14s in rings 9, 10, 11 and 12.

The rollers are fixed or movable to the frames of the planting machines during operation.

It is stated in [2] that when the working bodies are fixed, they are not able to adapt to the microrelief (unevenness) of the field surface, and any change in the position of the machine frame leads to a change in the depth of immersion of the working bodies. As a result, the stability of the machining depth, i.e. evenness, is not ensured. For this reason, the fixed attachment of the working bodies to the frame is used in machines with small coverage and deep tillage (plows, deep softeners, chisel cultivators). When hinged, the working bodies are mounted (connected) to the machine frame by means of suspension mechanisms. In this case, the working bodies will be able to adapt to the unevenness of the field surface, and changes in the position of the machine frame will not have a significant impact on their walking depth.

Figure 2 shows the scheme of attachment of the proposed combined roller to the frame of the planting machine.



1, 3-rama; 2, 4, 7, 10 - hinges; 5, 6 parallelogram mechanism levers; 8 pressure spring; 9 combined roller frame;

11- combined reel; 12 soil

Figure 2. Attachment of the combined roller to the frame by means of a parallellogram suspension mechanism

According to the scheme shown in Figure 2, we consider the quality of a mechanical system in which the degree of freedom of this oscillating system is equal. Let's make a calculation scheme of this oscillating mechanical system (Fig. 3).

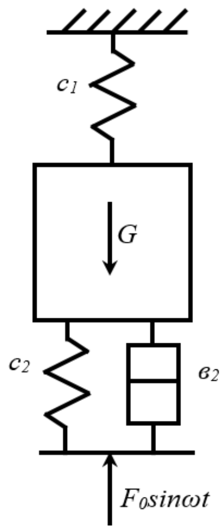


Figure 3. Calculation scheme of a vibrating mechanical system

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An oscillating system with the same degree of freedom as shown in Figure 3 performs a oscillating motion in the vertical direction under the action of a force F0sinōt, and it is under the influence of a constant gravitational force G. The oscillating system is attached to the machine body from the top by means of a pressure spring with a coefficient of elasticity s1. From the bottom, it interacts with soils with a coefficient of elasticity s2 and a dissipation coefficient b2.

To solve the problem, we first construct the equation of motion of an oscillating system

$$m\ddot{y} - mg + c_1 y - b_2 \dot{y} - c_2 y = F_0 \sin \omega t \qquad (1)$$

where m is the mass of the coil, kg; $\ddot{y}$ - generalized acceleration, м/с^2; $\dot{y}$ - generalized speed, m / s; F_0- driving force,H; g- free fall acceleration, м/с^2; ω- vibration frequency,с$^{-1}$; t- time, с.

One of the main requirements for the roller is that the sown seeds should be sufficiently compacted in the soil layer to ensure good interaction with the soil. The compressive strength applied to the soil depends in many respects on the volumetric compaction of the soil. Therefore, we express the deformation property of the soil as follows

$$c_2 y + в_2 \dot{y} = qSh, \qquad (2)$$

where q is the coefficient of volumetric compaction of the soil, N / m3; S-compacted soil surface, m2; h is the thickness of the soil to be compacted, m.

Given Equation (2), we write Equation (1) as follows

$$m\ddot{y} - mg + c_1 y - qSh = F_0 \sin \omega t \qquad (3)$$

(3) Divide both sides of the equation by m

$$\ddot{y} - g + \frac{c_1 y}{m} - \frac{qSh}{m} = \frac{F_0}{m} \sin \omega t \qquad (4)$$

For convenience in subsequent calculations, we write Equation (4) as follows

$$\ddot{y} + \frac{c_1 y}{m} = g - \frac{qSh}{m} - \frac{F_0}{m} \sin \omega t \qquad (5)$$

According to [3], the oscillation frequency in linear oscillations is expressed as follows

$$\sqrt{\frac{c_1}{m}} = \omega \qquad (6)$$

Next, we write the final equation of motion of an oscillating system with equal degrees of freedom as follows

$$\ddot{y} + \omega^2 y = g - \frac{qSh}{m} - \frac{F_0}{m} \sin \omega t \qquad (7)$$

(7) The differential equation is a second-order non-homogeneous linear equation with a constant coefficient. Therefore, according to [4], the general solution of a non-homogeneous equation is expressed as the sum of y2, the general solution of a homogeneous equation corresponding to a particular solution of this equation y1, i.e.

$$y = y_1 + y_2 \qquad (8)$$

First of all, a homogeneous equation $\ddot{y}+\omega^2 y=0$ we solve. In this case, the characteristic equation is as follows

$$k^2+\omega^2=0. \quad (9)$$

The general solution of a homogeneous equation is expressed as follows

$$y_1=C_1\sin\omega t+C_2\cos\omega t. \quad (10)$$

In the next step, we solve the non-homogeneous equation. His solution $y_2=A+t(B\sin\omega t+C\cos\omega t)$ apparently looking for. Its first and second derivatives are as follows

$$\dot{y}=B\sin\omega t+C\cos\omega t+t\left(B\omega\cos\omega t-C\omega\sin\omega t\right),$$

$$\ddot{y}=2B\omega\cos\omega t-2C\omega\sin\omega t+t\left(-B\omega^2\sin\omega t-C\omega^2\cos\omega t\right).$$

Putting the above into equation (7), we obtain the following

$$2B\omega\cos\omega t-2C\omega\sin\omega t+t\left(-B\omega^2\sin\omega t-C\omega^2\cos\omega t\right)+A\omega^2+tB\omega^2\sin\omega t+tC\omega^2\cos\omega t=g-\frac{qSh}{m}-\frac{F_0}{m}\sin\omega t$$

$$2B\omega\cos\omega t-2C\omega\sin\omega t+\omega^2A=g-\frac{qSh}{m}-\frac{F_0}{m}\sin\omega t$$

In this case, A, B and S are constant coefficients to be determined. We define them as follows

$$\begin{cases}A\omega^2=g-\dfrac{qSh}{m}\\ 2B\omega=0\\ 2C\omega=\dfrac{F_0}{m}\end{cases}, \quad \Rightarrow \quad \begin{cases}A=\dfrac{g}{\omega^2}-\dfrac{qSh}{\omega^2 m}\\ B=0\\ C=\dfrac{F_0}{2m\omega}\end{cases}$$

So, the general solution is as follows

$$y_2=\frac{g}{\omega^2}-\frac{qSh}{\omega^2 m}+\frac{F_0}{2m\omega}t\cos\omega t. \quad (11)$$

Considering the above, the solution of equation (7) is as follows

$$y=y_1+y_2=C_1\sin\omega t+C_2\cos\omega t+\frac{g}{\omega^2}-\frac{qSh}{\omega^2 m}+\frac{F_0}{2m\omega}t\cos\omega t. \quad (12)$$

Agar $y(0)=0,\ \dot{y}(0)=0$ then Equation (7) looks like this

$$y=\left(\frac{qSh}{\omega^2 m}-\frac{g}{\omega^2}\right)\cos\omega t-\frac{F_0}{2m\omega^2}\sin\omega t+\frac{g}{\omega^2}-\frac{qSh}{\omega^2 m}+\frac{F_0}{2m\omega}t\cos\omega t \quad (13)$$

In the next stage of the work, we will determine and calculate the incoming parameters.

First we determine the coefficient of elasticity of the pressure spring. It is worth mentioning the design features of the springs most commonly used in agricultural machinery [5]:

- relatively high values of their geometric parameters: initial length (height) and diameters of springs;

- the winding angles of such springs are in the range of 4o… 8o;
- As a rule, such spiral springs are made of circular surface wires.

We determine the coefficient of elasticity of the pressure spring using the Wood formula as follows [6]

$$c_1 = \frac{Ed^4}{8D_0^3 n(1 + \frac{d}{2D_0} - \frac{d^2}{2D_0^2})} \qquad (14)$$

in this *E*- shear elastic modulus, Н/мм^2; *d*- the diameter of the spring wire, мм; D_0- average diameter of spring, mm; n is the number of working packages, pcs.

Using the following unwanted parameters, we calculate the value of the coefficient of elasticity of the pressure spring by performing a numerical solution of expression (14), where E=89000 Н/мм^2, d=5 мм, D_0=45 мм, n=15. In that case, the coefficient of elasticity of the pressure spring $c_1 \approx 5$ Н/мм as long as it happens.

m=15 кг the oscillation frequency of the pressure spring in the operating mode when $\omega = \sqrt{\frac{1}{3}}$ .c^{-1}.

In doing so, the combined roller carries out a harmonic oscillation during the compaction of the soil and exchanges kinetic energy with the soil. In fact, free harmonic oscillations arise from the exchange of kinetic energy or potential energy. Systems that perform such vibrations must consist of inert or of course flexible elements. However, the free oscillation frequencies of mechanical systems with the same elements depend not on the parameters of the elements but on the initial conditions. It is also expedient to apply the results of the research in the calculation and design of vibrating working bodies of other types of technological machines.

The results of the research conducted in detail in the calculations and design of the working bodies of the co-operative system in technological machines of various designations.

References

1. Тухтакузиев, А., Мансуров, М. Т., & Тошпулатов, Б. У. (2019). ИССЛЕДОВАНИЕ РАВНОМЕРНОСТИ ГЛУБИНЫ ОБРАБОТКИ ПОЧВЫ ПОЧВООБРАБАТЫВАЮЩИМИ МАШИНАМИ. In *ВКЛАД УНИВЕРСИТЕТСКОЙ АГРАРНОЙ НАУКИ В ИННОВАЦИОННОЕ РАЗВИТИЕ АГРОПРОМЫШЛЕННОГО КОМПЛЕКСА* (pp. 382-387).
2. Ботиров, А. Г., Негматуллаев, С. Э., & Мансуров, М. Т. (2018). ГНЕЗДУЮЩИЙ АППАРАТ СЕЯЛКИ. *Экономика и социум*, (5), 223-227.
3. Ботиров, А. Г., & Мансуров, М. Т. (2017). УСОВЕРШЕНСТВОВАНИЕ ПОСЕВНОЙ СЕКЦИИ. *Научное знание современности*, (6), 48-51.
4. Абдулхаев, Х. Г., & Мансуров, М. Т. (2017). ВЛИЯНИЕ УГЛА НАКЛОНА К ГОРИЗОНТУ ТЯГИ РОТАЦИОННОГО РЫХЛИТЕЛЯ НА ПОКАЗАТЕЛИ ЕГО РАБОТЫ. In *Научно-практические пути повышения экологической устойчивости и*

ISSN 2697-2212 Online: https://academicjournal.io

социально-экономическое обеспечение сельскохозяйственного производства (pp. 1219-1221).

5. Мансуров, М. Т., & Расулов, А. Д. (2016). Теоретическое обоснование параметров выравнивателя-уплотнителя комбинированной машины по системе push-pull для предпосевной обработки почвы. *Молодой ученый*, (8), 256-259.
6. Tukhtakuziyev, A., & Mansurov, M. T. (2015). Research of stability of tractor with frontand rear-mounted tools against sidewise skidding. *Tractors and Agricultural Machinery*, (9), 34-35.
7. Tuhtakuziev, A., & Mansurov, M. T. (2015). Issledovanie ustojchivosti traktora s orudijami perednej i zadnej naveski protiv bokovogo zanosa. *Traktory i sel'hozmashiny*, (9), 34-35.
8. Tukhtakuziev, A., & Mansurov, M. T. (2015). Research of resistance on the tractor equipped with implements at front and backside lift hitch contrarily the sidewise skidding. *Europaische Fachhochschule*, (6), 76-77.
9. Tuhtakuziev, A., & Mansurov, M. T. (2015). Issledovanie ustojchivosti traktora s orudijami perednej i zadnej naveski protiv bokovogo zanosa. *Traktory i sel'hozmashiny*, (9), 34-35.
10. Мансуров, М. Т., & Тухтакузтев, А. (2015). Исследование устойчивости трактора с орудиями передней и задней навески против бокового заноса. *Тракторы и сельхозмашины.-2015.-№ 10.-С. 34-35.*
11. Тухтакузиев, А., & Мансуров, М. Т. (2015). Исследование устойчивости трактора с орудиями передней и задней навески против бокового заноса. *Тракторы и сельхозмашины*, (9), 34-35.
12. Тухтакузиев, А., & Мансуров, М. Т. (2015). Исследование устойчивости прямолинейного движения трактора с орудиями передней и задней навески. In *Интеллектуальные машинные технологии и техника для реализации Государственной программы развития сельского хозяйства* (pp. 125-128).
13. Тухтакузиев, А., & Мансуров, М. Т. (2015). Исследование устойчивости прямолинейного движения трактора с орудиями передней и задней навески. In *Интеллектуальные машинные технологии и техника для реализации Государственной программы развития сельского хозяйства* (pp. 125-128).
14. Тухтакузиев, А., Мансуров, М., Расулжонов, А., & Каримова, Д. Научные основы обеспечения равномерности глубины работы почвообрабатывающих машин. *Ташкент: Издательство TURON-IQBOL.–2020*.
15. Абдулхаев, Х. Г., & Мансуров, М. Т. (2017). Влияние угла наклона к горизонту тяги ротационного рыхлителя на показатели его работы. In *Научно-практические пути повышения экологической устойчивости и социально-экономическое обеспечение сельскохозяйственного производства* (pp. 1219-1221).
16. Мансуров, М. Т., & Тухтакузтев, А. (2015). Исследование устойчивости трактора с орудиями передней и задней навески против бокового заноса. *Тракторы и сельхозмашины.-2015.-№ 10.-С. 34-35.*

17. Tukhtakuziev, A., & Mansurov, M. T. (2015). Research of resistance on the tractor equipped with implements at front and backside lift hitch contrarily the sidewise skidding. *Europaische Fachhochschule*, (6), 76-77.

18. Тухтакузиев, А., Мансуров, М., Расулжонов, А., & Каримова, Д. Научные основы обеспечения равномерности глубины работы почво-обрабатывающих машин. *Ташкент: Издательство TURON-IQBOL.–2020*

19. Мансуров М.Т. Научно-технические решения агрегатирования почвообработывающих машин, состоящих из рабочих частей, навешиваемых спереди и сзади на колесные тракторы. Автореферат дисс. ... доктора техн. наук (DSc). – Ташкент, 2018. – 54 с.

20. Qosimov K., Yuldashev Sh. Erosion of the working surface of the metal to weld sheeting with the metal powder and surpassing solid for metals' erosion. International Journal of Advanced Research in Science, Engineering and Technology. vol. 6, Issue 10, October 2019.- h. 11147-11152.

21. Mansurov M.T, Nabijanov M.M. Factors influencing the work of parts and its exclusion methods // The collection includes scientific-materials of the International conference participants on the theme of "Innovation in mechanical engineering, energy saving technologies and increasing the efficiency of using resources". Part 1, May 28-29, 2021 Namangan city. – PP 119-124.

22. Mansurov M.T, Yusubjanova M. // Modern methods of diagnostics of main pipelines analysis // The collection includes scientific-materials of the International conference participants on the theme of "Innovation in mechanical engineering, energy saving technologies and increasing the efficiency of using resources". Part 1, May 28-29, 2021 Namangan city. – PP 475-476.

23. https://www.indianjournals.com/ijor.aspx?target=ijor:aca&volume=11&issue=6&article=102