The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.12635156

OSCILLATING PLOUGHSHARE FOR HARVESTING ROOT CROPS

PAYZIYEV GAYBULLA KADIROVICH

PhD, Associate Professor, Namangan Institute of Civil Engineering.

Annotation

The article discusses the issue of using oscillating shares in potato harvesters with the aim of communicating forced oscillations to the share, which allows you to reduce tractive effort due to the separation in time of the processes of cutting, lifting and deformation of the soil layer, as well as due to the perception by the drive of some part of the resistance, overcome by a ploughshare. The use of an oscillating share for digging in the soil is also advisable from the point of view of the best energy use of the tractor.

Keywords: Varying Plowshare, Strawberries of the Potatoes, Elevator, Console Beem, Сепация Lattice, Balance Plowshare, Oscillatory Motion, Deformation of Ground, Flexibility.

INTRODUCTION

Oscillating ploughshares are widely used in screening machines for harvesting potatoes, root crops and onions: KGP-2, KVN-2, KG-2, KKU-2, KKG-1, 4, LKG-1, 4 and LKP-1, 8. The role of the ploughshare in this case is performed by the leading edge of the screen [1]. The oscillating ploughshare is also used in elevator-type machines. In this case, it usually has a rigid connection with the suspension and a hinged connection with the connecting rod (Fig. 1). This implementation determines a special law of relative displacement in oscillatory motion: not plane-parallel (as in a ploughshare connected to an oscillating sieve), but pendulum along a circular trajectory. At the same time, different points of the ploughshare and the associated separation grid move along different trajectories, which makes it difficult to optimize them and reduces the transporting capacity. The highest speed of reservoir transportation along the surface of the ploughshare is provided when the direction of oscillation is located to the plane of the ploughshare "at an angle" $\beta_{opt} = 13 - 15^0$. In a pendulum ploughshare, the cutting edge oscillates at an angle $\beta_2 < \beta_{opt}$, and the ends of the separating grating are at an angle $\beta_2 > \beta_{opt}$ (Fig. 1, a). The works of Dubrovsky A.A., Eggenmuller A., Petrov G.D., Sorokin A.A., Didenko N.F. and other scientists are devoted to the study of oscillating ploughshares in screening machines [2].

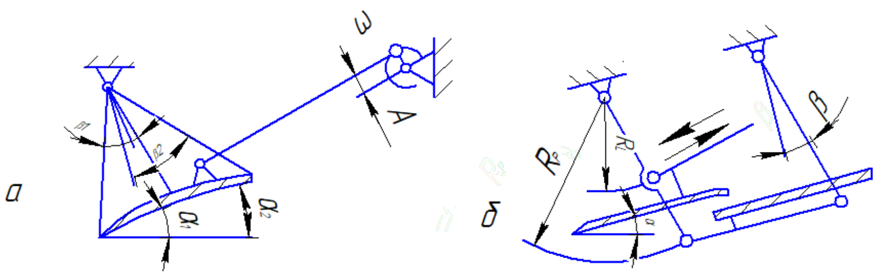

Fig 1: The scheme of the oscillating plowshare of the elevator machine: a - pendulum; b - with an active grid.

ISSN 1533-9211
DOI: 10.5281/zenodo.12635156

In tiny machines, the oscillating plowshare (Fig. 2) oscillates along an arc with a radius equal to the length of the suspension l_p. Considering that the crank radius (amplitude) And significantly less than the length of the suspensions, and the ratio A/l_n is close to zero, the reciprocating motion of the ploughshare is assumed to be rectilinear, directed at an angle (α+β) to the horizontal plane.

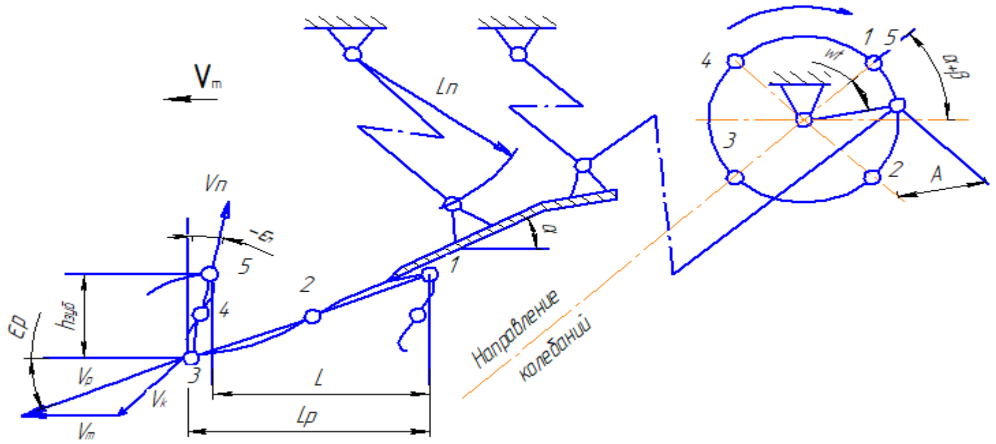

Fig 2: The scheme of movement of the oscillating ploughshare in absolute motion.

During operation, the absolute speed of the ploughshare consists of the translational speed of the machine V_M and the speed of the oscillatory motion of the ploughshare itself ω_A. As a result of the addition of these velocities in absolute motion, the ploughshare describes a sawtooth trajectory. The shape and dimensions of the trajectory depend on the amplitude, frequency and direction of vibrations, as well as on the speed of translational movement of the ploughshare and are determined by the height of the teeth $h_{зуб} = 2A\sin(\alpha + \beta)$ and the length of the ploughshare path during one period of oscillation.

$$L = V_M t_{col} = (\frac{2\pi}{\omega})V_M$$

The process of digging up a soil layer with an oscillating ploughshare can be divided into two periodically recurring phases: cutting, when the direction of movement of the ploughshare during oscillatory motion coincides with the direction of movement in portable motion, and tossing, when these movements are opposite to each other.

In the cutting phase (Fig. 2), the ploughshare moves from point 1 to point 3, while its speed increases in the interval between points 1-2, and decreases between points 2-3.

The values of resistance and the nature of soil deformation in the cutting phase are determined by the values of the cutting angle (crumbling). For a passive ploughshare, this angle is usually the angle of its inclination, for an oscillating one, the cutting angle depends on both the angle of inclination and the operating mode and is determined by the ratio:

ISSN 1533-9211
DOI: 10.5281/zenodo.12635156

$$\alpha_p = \alpha - \varepsilon_p,$$

Where α is the angle of inclination of the ploughshare;

e_p is the angle between the direction of movement of the ploughshare in the cutting phase and the horizontal.

The angle e_p is not constant and at each moment is determined by the ratio of the components of the absolute speed of the ploughshare vp in the cutting phase: vertical $V_{р\cdot в} = \omega A sin\omega t.$ $\sin(\alpha + \beta)$ to the horizontal:

$$V_{р\cdot г} = V_M + \omega A sin\omega t. \sin(\alpha + \beta)$$

$V_{p.г} = V_M + \omega A \sin \omega t . \cos(\alpha + \beta)$, т.е. $tg\ \varepsilon_p = V_{r\cdot v}/V_{r\cdot g}$ - However, with sufficient accuracy, it can be assumed that in the cutting phase

$$tg\ \varepsilon_p = \frac{2A\sin(\alpha + \beta)}{\pi V_M + 2\omega A cos(A + B)}$$

The value of the angle ap has a significant effect on the power consumed by the oscillating plowshare, especially on its traction component (Fig. 3.).

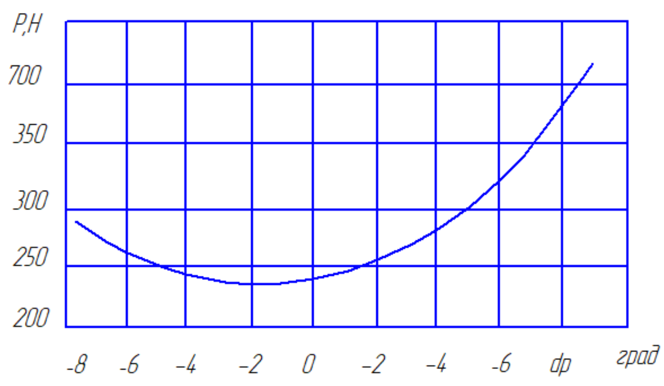

Fig 3: The dependence of the traction force on the angle of the α_p

The process of deformation of loamy and clay soils under the action of an oscillating dihedral wedge in the cutting phase depends on the ratio of angles α and ε_p.

Если $\varepsilon_p = \alpha$ и угол резания $\alpha_p = 0,$ то

$$\omega A = 1.57 V_M \frac{\sin\alpha}{\sin\beta}$$

In this case, the deformation of the soil is characterized first by elastic, and then by plastic compaction in the plane of the working surface of the ploughshare. The cut layer, without receiving an upward force impulse, remains at rest (Fig. 4, a). In general, the lifting height of the cut soil at the end of the cutting phase is determined by:

ISSN 1533-9211

DOI: 10.5281/zenodo.12635156

$$\Delta h = Ip(tg\,\alpha - tg\,\varepsilon_p).$$

At $\alpha = \varepsilon_p$, the height of the reservoir rise $\Delta h = 0$, i.e. the cut soil layer remains at rest; the resistance of the cut soil when overcoming the inertia of rest in the cutting phase is absent, and the resistance R is gone.when digging up the soil with an oscillating ploughshare, it can be taken equal to the product of the cross-sectional area of the ploughshare F_l by the hardness of the soil N_p

$$R_{lez.k} = H_n F_l.$$

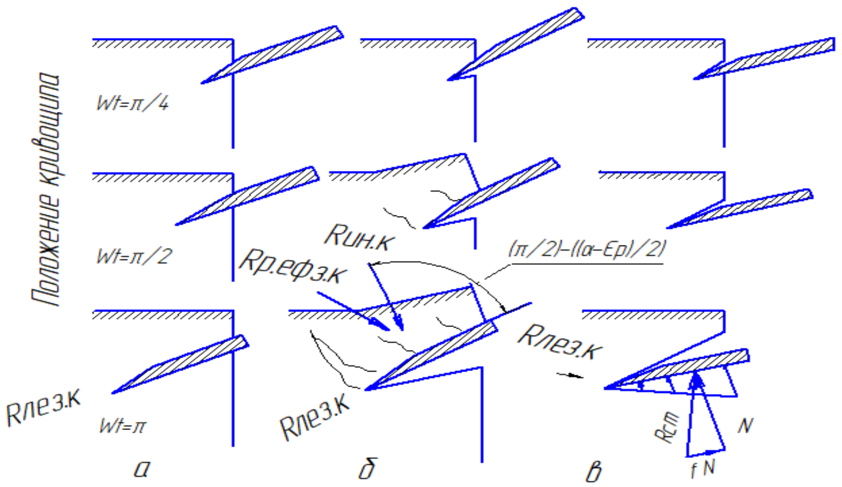

Fig 4: The nature of the deformation of the soil layer in the cutting phase when digging it with an oscillating ploughshare: a -at $\alpha_p = 0$; b - at $\alpha_p > 0$; c - at $\alpha_p < 0$

If $\varepsilon_p < \alpha$ (Fig.4, b), then the nature of soil deformation during the introduction of an oscillating plowshare is similar to deformation during operation of a passive plowshare installed at an angle$(\alpha - \varepsilon_p)$. Then, in the cutting phase, the ploughshare over comes the dynamic force, which is determined by the dependence:

$$R_{in\cdot k} = 2V_p^2 bhP_{06}\sin[\frac{\alpha - \varepsilon_p}{2}]$$

In the case under consideration, the oscillating plowshare, like the passive wedge, overcomes all kinds of soil resistance: the blade has penetrated$R_{lez.k}$; deformations$R_{def.k}$; formation weights$R_{g.k}$, friction forces F and inertia of rest $R_{in.k}$.

The modes of operation of the ploughshare, corresponding to the lowest energy consumption, occur under the condition $\varepsilon p = \alpha$, т.е. $\omega A = 1.57 V_M \frac{\sin\alpha}{\sin\beta}$, for better performance of the technological process (crumbling of the soil layer), the modes in which $\varepsilon_p < \alpha$ are most preferable.

The Seybold REPORT

ISSN 1533-9211

DOI: 10.5281/zenodo.12635156

If $\varepsilon_p > \alpha$ (Fig.4, c), then the lifting height Δh has a negative value. This condition corresponds to the operating modes of the ploughshare, in which:

$$\omega A > 1.57V_M \frac{sin\alpha}{sin\beta}$$

Such modes are unacceptable, since in the cutting phase, the lower surface of the ploughshare (the back of the blade) compacts the soil layer with a height of Δh at the bottom of the furrow. The result of the seal is the occurrence of normal pressures on the back of the blade, the resultant of which, together with friction forces, gives the resulting crumpling force R_{st}. The value of this force is most influenced by the height of the crushed soil layer Δh, which in turn, the greater the difference between the angles ep and α.

The force Rcm not only increases the pulling force required to move the ploughshare, but also tends to push the ploughshare out of the soil, which can eventually lead to the ploughshare being hollowed out and to a significant increase in vibrations of the machine frame.

Considering the above, the sinking of the oscillating ploughshare into the soil must be performed only when the machine begins to move, i.e. it will have a translational velocity of vm.

In the second phase, the tossing phase, when moving the ploughshare from point 3 to point 5 (see Fig. 2) the direction of its absolute motion is determined by the angle of the ep toss, which can also be assumed constant for the entire phase and determined from the ratio:

$$tg\varepsilon_p = \frac{\pi V_M}{2\omega \operatorname{asin}(\alpha + \beta)} - ctg(\alpha + \beta \qquad (2)$$

Soil deformation in the tossing phase at low values of crumbling angles is characterized by the formation of soil lumps in each oscillation cycle.

In the initial period, the elastic compaction of the lower layers of the cut soil occurs, then a cleavage crack appears in front of the cutting edge of the ploughshare and a prism-shaped lump of soil is formed. During the subsequent oscillation cycle, the formed block continues to move up the surface of the ploughshare, and a new layer of soil is cut off with the blade.

The chips formed during the operation of the oscillating ploughshare on loamy and clay soils at a great depth of excavation (15-20 cm) and optimal humidity have cracks only in the lower layer, and at a depth of 8-10 cm - separation cracks throughout the thickness of the layer. When digging up dry cohesive soil with a ploughshare, irregularly shaped soil blocks are torn off in several cycles of vibrations.

Thus, the communication of forced vibrations to the ploughshare makes it possible to reduce the pulling force due to the separation in time of the processes of cutting, lifting and deformation of the soil layer, as well as due to the perception by the drive of some of the resistances overcome by the ploughshare. Therefore, the use of an oscillating ploughshare for digging up the soil is also advisable from the point of view of better energy use of the tractor.

The Seybold REPORT

ISSN 1533-9211

DOI: 10.5281/zenodo.12635156

CONCULATION

The most important technological indicator of the quality of the work of the digging working body is the speed of transportation of the cut soil layer.

The tests confirmed the high transporting capacity of the ploughshare, which provides an increase in the working speed of the machine from 0.8... 1.0 m/s (for tiny type machines) to 1.4 m/s and high efficiency of soil separation with a vibrating grate.

Reference

1) Petrov G.D. Potato harvesters. Moscow: Mashinostroenie, 1984, 320 p.

2) Khvostov V.A., Reinhart E.S. Machines for harvesting root crops and onions. (theory, construction, calculation). – M.: VISKHOM, 1995. – 391 p.

3) Sorokin A.A. On the calculation of the parameters of the oscillating (vibrating) ploughshare of a potato harvester // Tr. VISKHOM, issue 30, Moscow: 1981, 16 p.

4) Paiziev G.K., Fayziev Sh.G., Kadyrov A.R. Determination of the blade thickness of the potato harvester beater. //Universum: technical sciences: electron. scientific journal 2020. No.5(74). URL: http:/7universum . com/ru/tech/archive/item/9386

5) Otakhanov B.S., Paiziev G.K., Khozhiev B.R. Variants of the impact of the working body of the rotary machine on soil blocks and lumps //"Scientific Life", Moscow, 2014. No.2, pp. 75-78.

6) Payziev G.K. Physical and mechanikal properties of potato culture. Akademiya Globe: Inderscince Research. Volume 2, Issue 8, Aug, 2021 *Go to our website https://agir. Academiascience.org for more.*