Justifications of the longitudinal distance between the bodies of a two – tier plow

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Abstract. The article presents the results of theoretical research on the justification of the longitudinal distance between the bodies of the plough analysis of previous theoretical studies applied graph-analytic research methods and determined the smallest longitudinal distance that provides an unobstructed passage and rotation of the formation between the bodies of the soil.

1. Introduction

The longitude distance between bodies makes conditional on their metal consumption size aggregations, as well as tractate resistance. The Last is explained that on the one hand, these distances bring about to increase the mass of the plow and naturally to increase the effort spent on dragging in-furrow, but on the other hand, overweening reduction of this distance brings about as- a layer between the body that brings about increase tractive resistance plow.

The Basis of longitudes distance many teachers N.V.SCHuchkin concerned with between bodies [1] at choicely optimal distance between bodies base took of with plow vegetable remainders. M.N.Letoshnev, I.M.Smyrna S.S.Saakyan, and other coming from the condition of stability of the functioning (working) the plow, A.A.Knyazev [2.3], L.F.Smirnov [4] define this distances from the condition of the achievement of the zone to deforming the layer of the ground by the following body before constructive elements of the previous body, located along the wall of the furrow and contacting with her. The Analysis of the specified works allows concluding that at a determination of the longitudes distance between bodies it is necessary to come from nonobstanle binning together the layer of ground from condition free i.e. the longitudes distance between bodies must be such, under which the zone of deforming the layer of the ground by bodies must not reach the constructive element of the previous body.

The Longitudes distance of cut in plow is defined also from the requirement of normal flowing of the technological process of the plowing.

We shall consider the interactions of the body with a layer of ground, as the scythe of the wedge with salient of ground, opened on the one hand.

A real corner of pinning together the layer is defined from soil conditions (corner of friction) and parameters of the plowshare on the known expression

\[ \psi = 90^\circ - \frac{\beta + \varphi}{2} + \varphi \]  

(1)

Where \( \beta \) is a corner of the installing the plowshare to bottom of the furrow
\( \varphi^1 \) is a corner of friction of ground about ground

\( \varphi \) is a corner of friction of ground about steel

Studying the influences to velocities on the corner of the slopping to planes of binning together to horizon V.Kiryuhin [5] concluded that this corner changes with the increase of velocities. To such conclusion came Y.U.F.Novikov [6] who has installed that hrowth to velocities from 0,5 1,3 before 2,5 3,5 m/with relatively little influences upon corners of the slopping to planes of binning together horizontal \( j_r \) and vertical \( j_b \) planes. Y.F.Novikov has offered the following formulas for determination in these corners.

\[
\phi_I = \frac{\pi}{2} - \left\{ \left( \frac{0.58 + 0.493}{\tau_{np} + 1} \right) - \arctg \left( \frac{0.577 f_n \tan \theta_0}{0.468 f \tan \theta_0 + \tau_{np}^{0.706}} \right) \right\}
\]

\[
\phi_B = \frac{\pi}{2} - \left\{ \left( \frac{0.56 + 0.18}{\tau_{np} + 1.12} \right)^{0.85+0.75 \tau_{np}} - \arctg \left( \frac{24.7 a \rho_0 f \cdot f_n \tan \alpha_0 \cos \alpha_0}{26.8 a \rho_0 \cos \alpha_0 \tan \alpha_0 + \eta_{np}^{0.78}} \right) \right\}
\]

Where \( \tau_{np} \) is limiting resistance shift

\( f, f_u \) are factors of friction of ground about metal and ground about the ground.

\( \theta_0 \) is a corner of the slopping of the blade of the plowshare to walls of the furrow.

\( \rho_0 \) is a density of ground

\( \alpha_0 \) is a corner of the slopping worker to surfaces of the plowshare to the button of the furrow.

2. Methods

It has been found that values jars and \( j_b \) in big degree hang from the physics-mechanical characteristic of the ground than from geometric parameter worker organs, but changing of the factor of friction of ground about metal in greater degree influences upon \( y \).

From picture distances between bodies

\[
L = l_1 + l_2 + l_3 - l_l
\]

where: \( l_l \) is a flight of the field edge of dump surface of the body, \( l_2 \) is a size emerging back frequent shoe along the field edge of the body, \( l_3 \) is a longitudes distance from the heel of the plowshare before the point of the output on the lid of the wall of the furrow to planes of putting together a layer of ground, \( l_l \) is a projection on longitudes lengths of blade plowshare.
from triangle ABC on a theorem of sine’s

$$\frac{BC}{\sin(90+\delta)} = \frac{AC}{\sin[90^0-(\gamma+\delta)]} = \frac{BC}{\sin\gamma} \tag{3}$$

$$AB = \frac{\delta}{\sin\gamma} \tag{4}$$

$$BK = l_1 = \delta \cdot \text{ctg}\gamma \tag{5}$$

From figure 1 and (3)

$$l_3 = \frac{AB \cdot \sin(90+\delta)}{\sin[90^0-(\gamma+\delta)]} \tag{6}$$

With calculation for (4) and transformation

$$l_3 = \frac{\delta}{\sin\gamma} \cdot \frac{\cos\delta}{\cos(\gamma+\delta)} \tag{7}$$

Having Put (deliver) (5) and (7) in (2) and having simplified, we shall get expression longitude distances between bodies.
\[ L = l_1 + l_2 + \delta \cdot \tan(\gamma + \delta) \] (8)

where \( \delta \) is the transformed on a horizontal plane of corners of lateral butting together (the epidemic deather) on planes the Corner \( \delta \) is defined by the expression

\[ \delta = \arctan\left(\frac{\theta}{2 \cos \psi}\right) \]

where \( \frac{\theta}{2} = 45^\circ - \frac{\psi}{2} \) is a half corner of the epidemic deathless.

The Analysis (8) shows that an increase in the width of the seizure of the body engages other value of the distance \( L \) between bodies, besides the reduction of the sizes of the flight of the field edge of surfaces and shoe longitudes distance between bodies of the body.

3. Results and Discussions

We shall Define the least width of the bright spot between bodies in bodies in the orthogonal section from a condition that the dumping layer is not deformed (take conditionally).

Beside cut in bodies this process occurs several otherwise since the under plough layer ground with the thickness of 10-15 cm process plowshare without a turn of the layer, but on the width of the bright spot between the bodies in orthogonal section, in this case, affects only dump layer with a thickness of up to 30 cm (the rice 2).

![Figure 2. The rice 2](image)

\[ l_0 = l_\delta + D \]

Where \( l_\delta \) is a size on horizontal of the bright spot between bodies in projections on orthogonal to moldboard of body plane
\( l_\delta \) is a projection on orthogonal to mouldboard body plane of the thickness of the shoe on horizontal, measured on the height from supporting plane of the body, equal to a depth of the processing.

\( D \) - a value diagonal of the layer.

From the accreted condition of deformation

\[
D = \sqrt{a^2 + b^2}
\]

Then

\[
l_0 = l_\delta + \sqrt{a^2 + b^2}
\]

We shall define the least longitude distance between bodies of the plow from condition of the ensuring the free passing of the dumped layer. From triangles DFG and CEF

\[
DF + EF = DE = l_\delta + \sqrt{a^2 + b^2}
\]  

\[
DF = \frac{b}{\cos \gamma_0} \quad EF = l_\delta + \sqrt{a^2 + b^2} - \frac{b}{\cos \gamma_0}
\]

\[
FG = b \tan \gamma_0
\]

\[
CF = \frac{l_\delta + \sqrt{a^2 + b^2} + \frac{b}{\cos \gamma_0}}{\sin \gamma_0}
\]

The Least possible longitude distance between cut in bodies since Ad and SN are

\[
L_{\text{min}} = CF + FG
\]

equal to having substituted (12) and (13) in (14) and having simplified, we shall get the expression defining between bodies of the plow from the condition of the free passage of the dumped layer

\[
L_{\text{min}} = \frac{l_\delta + \sqrt{a^2 + b^2} - b \cos \gamma_0}{\sin \gamma_0}
\]

Where \( \gamma_0 \) is a corner of the slopping forming moldboard to walls of the furrow measured on height, equal to the depth of the processing.

The Called on calculations show that under \( l_\delta = 30 \, \text{cm} \), \( a = 30 \, \text{cm} \), \( b = 35 \, \text{cm} \), \( \gamma_0 = 500^\circ \), \( L_{\text{min}} = 70 - 75 \, \text{cm} \)

4. Conclusions
From the analysis of the received results follows, that at the use of cut cases for processing ground on depth up to 40 cm, longitudinal distances between cases of a plough can be reduced by 20...25 cm on
comparison with two-story ploughs, that metal consumption of a plough and accordingly expense of energy for its dragging. The conclusion about longitudinal between cut cases can be made distance after the experimental check.

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