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Development Of A Front Plow For Smooth Furrowless Plowing With Corners

Kurbanov Sherzod Baxtiyorovich
Karshi Engineering Economic Institute, Karshi, Uzbekistan
Email: sherzod.020508@mail.ru

Abstract: The article provides a rationale for the parameters of the front plow angle gauge, which ensures high-quality implementation of the technological process according to agrotechnical requirements with the least energy consumption, as well as a design diagram of the front plow with angle gauges and a diagram for determining the longitudinal distance between the body and the angle gauge. Theoretical and experimental studies have established that the longitudinal distance between the body plowshare and the angle cutter is at least 27 cm and between the disc blade and the angle cutter 16 cm ensures the required quality of tillage of the front plow in accordance with established agrotechnical requirements.

Keywords: soil, front plow, body, smooth plowing, cornercutter, disc coulter, triangular wedge.

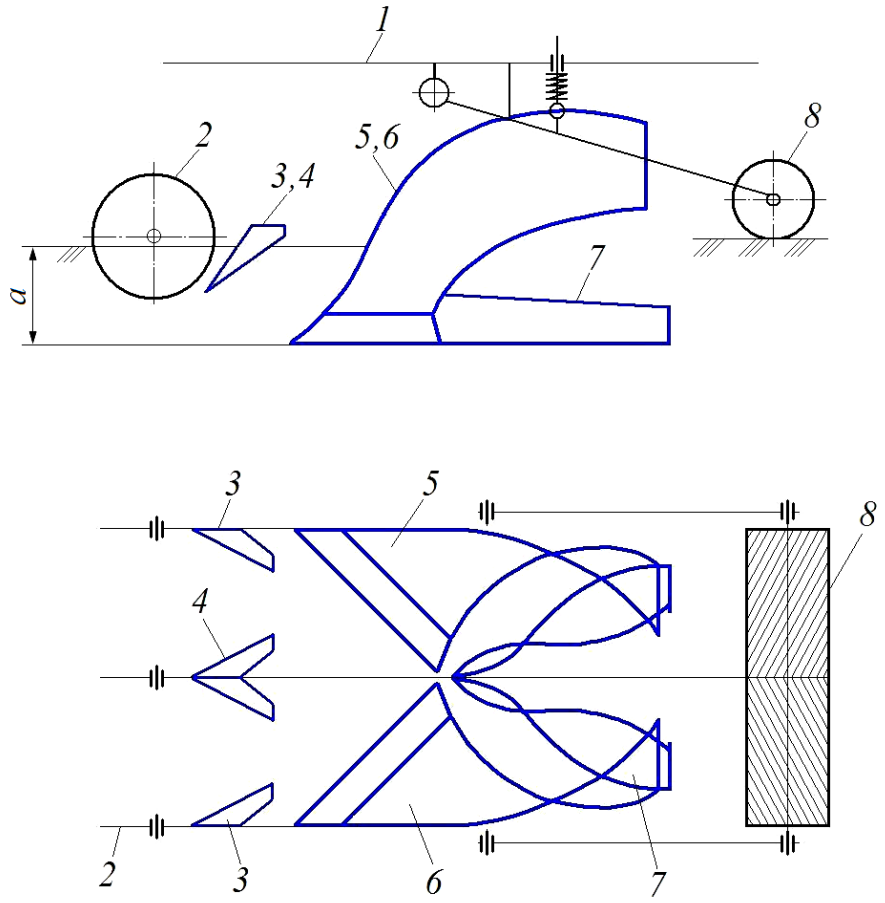
Introduction

In the world, one of the leading places is occupied by the development and use of energy-resource-saving and high-performance machines for basic soil cultivation. If we consider that "On a global scale, arable areas amount to more than 1.8 billion hectares," then the development of energy-resource-saving tillage machines and implements with high quality of work and efficiency is considered an important task. At the same time, much attention is paid to the development and use of plows that perform smooth plowing of fields without open furrows and fall ridges for sowing grain and secondary crops [1, 2].

Existing plows for smooth, furrowless plowing have a number of disadvantages, including they do not provide complete rotation of layers within their own furrow and incorporation of weeds, and have high energy intensity [3]. This leads to soil cultivation with insufficient quality and reduced productivity [4].

Based on the analysis of the research work carried out, an improved technology for the rotation of layers within its own furrow by 180^0 and a design diagram of a frontal plow with angle marks for its implementation have been developed [5].

The front plow consists of a frame 1 equipped with a hinged device, disc knives 2, angle marks 3 and 4, left and right turning bodies 5 and 6, a plow 7 and a support-leveling roller 8. One-sided angle marks are installed only along the line of the field edges of the outer bodies, and symmetrical angles - along the axis of symmetry of opposite buildings (Fig. 1).



1 – frame; 2 – disk knife; 3, 4 – angular symbols; 5, 6 – left and right turning housings; 7 – plunderer; 8 – skating rink

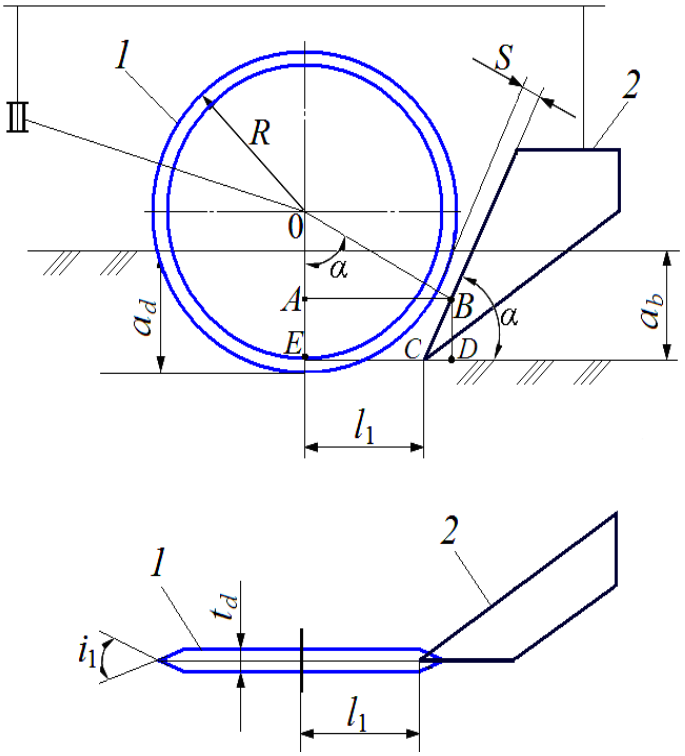
Fig 1. Structural diagram of a front plow with angle marks

The rational location for installing the angle gauge is taken to be behind the disk along its axis of symmetry (Fig. 2). In this position, the front edge of the angle remover moves along the gap formed by the disk, which improves its working process [6].

To protect the toe of the bevel from wear and reduce its traction resistance, install the lower edge *C* of the bevel at the level of the lower point *E* of the unsharpened surface of the disc. Then the longitudinal distance between the circular knife and the edge can be determined based on the exclusion of the front edge of the edge touching the disk blade

$$l_1 = (R+S)\sin\alpha - [R - \frac{1}{2}t_o ctg\frac{i_1}{2} - (R+S)\cos\alpha\ ]ctg\alpha\ , \qquad (1)$$

where R – is the radius of the circular knife, *cm*; S – gap between the blade of the circular knife and the front edge of the angle cutter, *cm;* α – angle of entry of the front face of the angle into the soil, degrees; t_o – thickness of the circular knife, *cm;* i_1 – sharpening angle of the circular knife, *degrees.* At R = 22.5 *cm*, S = 2 *cm*, α = 500, t_d = 0.5 cm and i_1 – 25^0, according to expression (1), the longitudinal distance from the axis of the circular knife to the toe of the angle grinder must be at least 16 *cm*.



1 – disk blade; 2 – let's figure it out

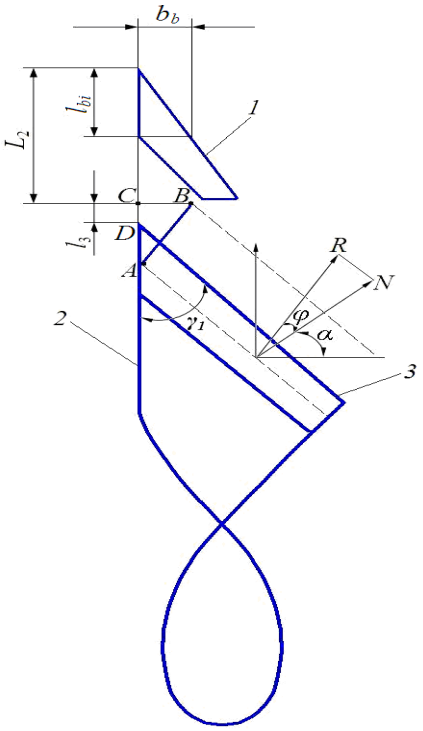
Fig.2. Scheme for determining the longitudinal distance (l_1) between the disk blade and the angle:

The longitudinal distance between the angle gauge and the body (Fig. 3) was determined based on the condition that the soil deformation zone treated by the body did not reach the structural elements of the angle gauge

$$L_2 \geq b_b ctg\gamma + (a - \frac{1}{2} b_k \sin\varepsilon_1) ctg\psi_{1l} \sin(\gamma_1 + \varphi) - \frac{b_l \sin\varepsilon_1}{\sin\gamma_1}, \quad (2)$$

where b_b – is the cutting width, *m;* γ – angle of angle, *degree;* ε_1 – angle of installation of the ploughshare to the horizon, *degree;* ψ_{1l} – angle of formation shearing in a plane in the direction of the resultant force on the ploughshare, *degree;* b_l – working width of the body plowshare, *m;* a – depth of processing of the hull, *m;* γ_1 – angle of installation of the ploughshare blade to the wall of the furrow, *degree;* b_k – body working width, *m*; φ – soil friction angle, degree.

At $a = 25$ *см*, $b_b = 10$ *см*, $b_k = 52{,}5$ *см*, $\gamma = 32^0$, $\gamma_1 = 45^0$, $\varphi = 25^0$, $\varepsilon_1 = 33^0$ and $b_l = 12{,}2$ *см* according to expression (2) the longitudinal distance between the angle and the body must be at least 27 cm.



1 – angle; 2 – body; 3 – ploughshare

Fig.3. Scheme for determining the longitudinal distance (L_2) between the body and the angle:

ased on the results of the studies, it was established that the required quality of soil cultivation with a front plow in accordance with established agrotechnical requirements with minimal energy consumption is ensured with longitudinal distances between the body plowshare and the angle cutter of at least 27 *cm* and between the disc blade and the angle cutter of 16 *cm*.

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