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THE LAW OF CHANGE OF THE ANGLE FORMING THE HORIZONTAL WHEN DIGGING A TEMPORARY DITCH

Abstract: *The article describes research on the improvement of the temporary ditch digger device and the laws of change of the horizontal forming angle during the creation of a temporary ditch. In order to reduce the traction resistance of the digger and improve the quality of the trench, straight discs are installed in front of the digger. During digging, the issue of resistance forces falling on the ploughshare of the working equipment was discussed.*

Keywords: *Irrigation, temporary ditch, disk, digger, deformation, tipper, ploughshare, support ski, ploughshare.*

In the irrigated lands of Central Asia, the method of irrigating agricultural crops from the soil level (by plowing and pressing) is widespread, and temporary irrigation networks are placed in the irrigation section in transverse and longitudinal schemes, depending on the conditions of the place.

Longitudinal placement schemes are used on land with a slope of less than 0.002. In such lands, the plot divider is inclined to the direction of the greatest slope, temporary ditches are taken perpendicular to the horizontals of height, and ditches are taken in the direction of a small slope. The beshamaks are built parallel to the ditches, and the water from each of them is distributed to 5-6 irrigation egates. Irrigation gates are opened in the direction of the large slope of the site, that is, they are parallel to the direction of the temporary ditch [1,2].

In order to prevent the washing of the soil under the influence of irrigation water, temporary irrigation networks are placed in a transverse scheme on the lands with a large slope. In such lands, the plot divider is taken perpendicularly or more obliquely to the horizontal height. The edges are taken in a direction at a small angle to the horizontal, and the irrigation egates are taken perpendicular to it. In this case, irrigation water is distributed to the owners directly from the wells [2,3].

It is known that improving land reclamation and increasing crop productivity depends on straight away irrigation. Irrigation networks are used to irrigate agricultural crops. Irrigation networks are divided into permanent and temporary networks according to the period of use. Temporary irrigation networks are removed at the beginning of the irrigation season and leveled at the end of the irrigation season. Digger-levellers are used for digging temporary networks: they cut the ditch at 20 - 40 1/sec. from 100 - 200 1/sec. it is selected taking into account the ability to pass water up to [3,4].

KOP-500A, KZU-0.5, KPU-2000A, KBN-0.35, KZU-0.3 ditch diggers are used to create temporary irrigation networks for irrigating crops in the irrigated agriculture of our republic. In addition to digging the soil, lifting the excavated soil and placing and pushing it on one or both sides of the canal bank, these ditch diggers need to perform the work of leveling and smoothing its surface and ensuring its slope [4].

The main disadvantage of this ditch digger is that it requires a lot of energy when digging a ditch in hard areas, the amount of large lumps increases in areas with low humidity, as a result of which the quality of softening decreases, and it loses the geometric shape of the working columns due to excessive deformation. Among them, a large amount of force is required to pull the work equipment in the process of digging a ditch, high soil resistance and high water absorption due to insufficient compaction of the bottom of the ditch.

In our scientific research, we have separately considered the laws of change of the γ angles that form the horizontal surfaces of the diggers for the lower part of the screed, because their tasks are different. [4,5].

The lower part of the plow is such a part of the plow's surface that it is at the lower level of the open surface of the field when cutting plants. Its main task is to cut a layer of a certain size and shape with the least consumption of energy, which is the main part of the traction resistance of the working body, and to raise the open surface of the field to a certain level. The working condition and function of the upper part of the coulters is similar to the working condition and function of the plow. According to Y.S. Petlach, their tensile strength does not exceed 10% of the total tensile strength [3,5,6]. The relatively small area of energy consumption in the upper part of the plows is explained by the fact that the working bodies affect the layer mainly with the ploughshare and the lower part of the plow. And the upper part only ensures the rotation of the layer and its displacement, for which a small part of the traction force is spent on it. From the point of view of energy consumption, it depends on its shape with the upper part of the oven, but the most convenient is a flat flat shape.

However, in order to ensure a smooth connection, it is necessary to increase the cutting angle to 900 at the point of connection with the lower part of the roller. As a result, the lower part of the carriage will not have a horizontal guide curve. It is known that the more curved the guide curve is, the greater the deformation of the soil, and as a result, the greater the pulling power of the working body [3,6,7].

The upper part of the dump is installed with different shapes according to the experiments conducted by Y.S.Potlakh and R.L.Turesky, whose shape has a great influence on the traction resistance.

Taking into account the specific characteristics to reach the roots of plants in the field, the upper part of the plow creates an opportunity not only to move the soil to the side, but also to get a high stable burial. For this, the angle formed from the height h to the upper part of the wheel must increase, but in our scientific research work at an angle greater than 2....9 degrees, the performance of the wheel shows that the angle formed at the top of the wheel well satisfies the condition of obtaining a stable load with its change. Based on this, according to N.V. Shuchkin's equation for semi-screw shafts;

$$\gamma = \gamma_h + \frac{Z_1^2}{2P} \qquad (1)$$

here γ_h - the angle formed by connecting the lower and upper parts of the dump;

$Z_1 - h$ the height forming the top of the dump, calculated from the height.

Taking into account the above and based on the conducted research, the law of change of the horizontal angle formed in the upper part of the horse was not determined.

We express the law of change of the horizontal angle formed at the bottom of the dump in the form of a parabola:

$$\gamma = \gamma_0 + Az^n \qquad (2)$$

here γ_0 - the angle formed by the connection of the bottom of the dump with the ploughshare;

Z - h the height forming the top of the dump, calculated from the height;

A, n - coefficients

Z = h-h$_0$, $\gamma = \gamma_n$ from the boundary conditions $A = \frac{\gamma_0 - \gamma_h}{(h - h_0)^n}$ we will have that.

We put the value of A in the equation of the parabola:

$$\gamma = \gamma_0 - (\gamma_0 - \gamma_h) \cdot (\frac{Z}{h - h_0})^n \qquad (3)$$

In the given interval from γ_0 to γ_h, we can change the value of the n-level coefficient to get different angle changes that form the horizontal. In this way, any convexity of the curvature of the corners of the generator is selected, which allows the surface of the wheel to be well adapted to the necessary working conditions of the working body.

As mentioned above, the lemex has the shape of a straight flat blade, like $\gamma_0 = 90^0$. Angle γ_h, which forms the junction of the lower and upper parts of the blade, has the smallest value in the traction resistance of the working body, according to the experimental data of M.E. Matesturo, A.Z. Mamedova, Y.S. Petlax, P.I. Slabadyuka and others, it is in the range of $40...45^0$.

In order to apply the formula, it is necessary to design and prepare a number of working bodies with the laws of change of generating (forming) angles, the optimal values of *n* are determined based on the following dynamometry of various values of n coefficients and obtained experimental data.

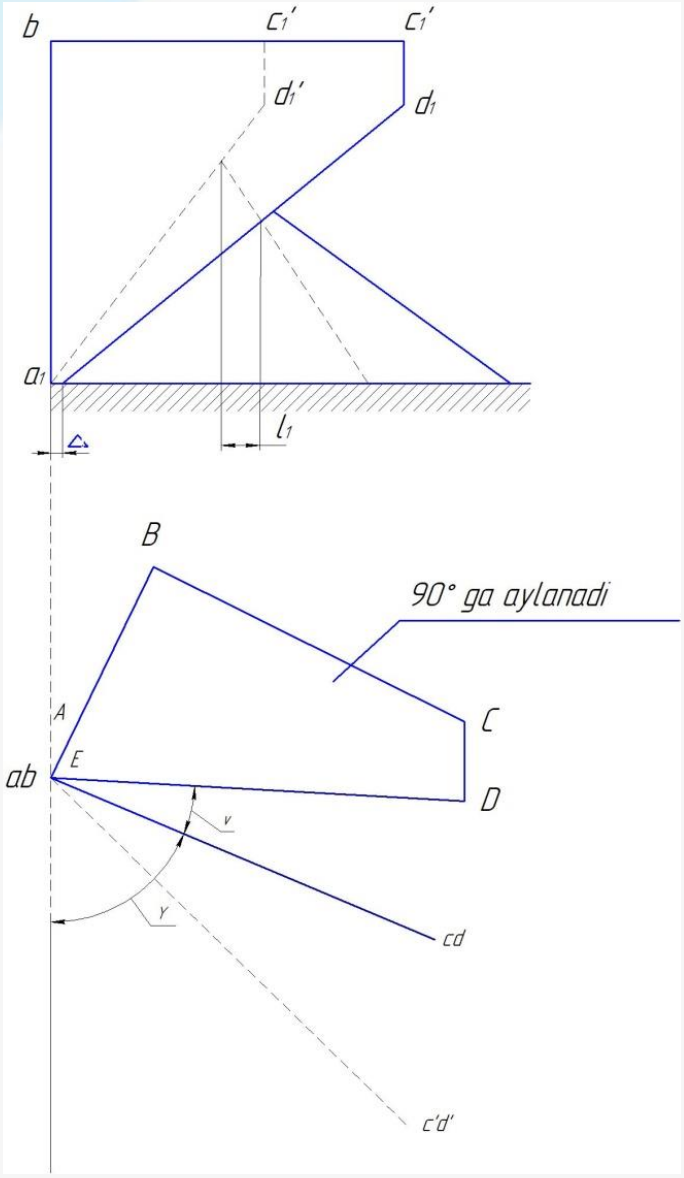
Existing trenchers for cutting indoor field (paical) vegetation are designed in such a way that the trench cut by these trenchers has the same slope angle of 450, and the same depth. As a result of this, up to 15% of the soil is spilled into the house under the canal after the passage of the digger [3,7,8].

As a result, the size of the banks of the canal and the permeability of the canal decrease. In this case, in order to eliminate the spillage of soil from the banks of the canal, its internal slope should be formed under the natural slope angle of the soil with an angle that is not too big for it. But depending on the type of soil and humidity, this angle varies in a wide enough range ($15^0...55^0$), it should be possible to change the angle of delivery of the inner slopes of the canal bank to the digger. For this purpose, a special device for the digger was developed from our research. A hinge was installed after the working body, which formed the banks of the canal, consisted of two planes. The internal slope angle of the canal banks is changed by turning λ_1 plane, and the angle of installation of the plane forming the canal banks to the direction of movement has the following relationship. (1-rasm).

$$m_1 = ctg\lambda_1 = \sin\gamma \times ctgv \qquad (4)$$

here m_1 is the slope transfer coefficient;

The angle of the lower cutting plane of the v-channel bank generator..



Picture 1. Scheme of operation of the digger

As can be seen from the above expression, as the angle γ increases, the slope angle λ of the canal banks decreases and becomes less than $\gamma = 90^0$. From the point of view of the energy consumption of the formation of channel banks, the plane of the channel generator should be set at such an angle γ that the traction resistance is small, and the volume of the moved soil is large. To determine the optimal angle γ_{opt} of setting the plane of the channel bank to the direction of movement, the equation of movement of the soil along the working surface of the working equipment wheel is used:

$$tg\varphi = \frac{f_1}{f + f_1} ctg\gamma \qquad (5)$$

where φ is the angle between the actual direction of soil movement and the plane of the channel bank;

f, f_1 – coefficient of rolling friction.

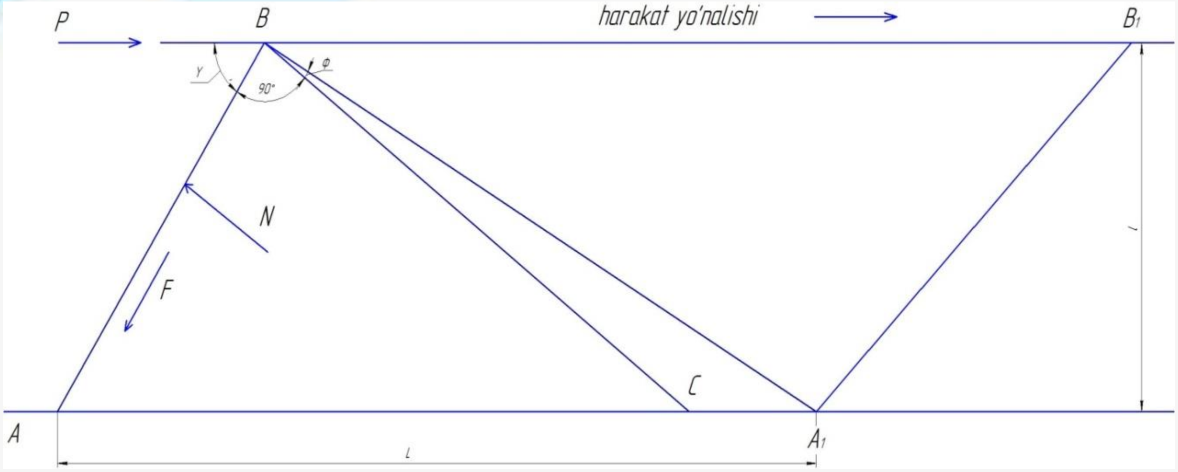


Figure 2. The scheme for determining the traction resistance of the digger

It should be taken into account that (5) formula γ is valid within the limit of angle change from 25^0 to 60^0.

In the stable movement of the trencher, at each interval, the path of L = BB_1 should pass for the complete settlement of the soil with the plane of the trencher bank (2 - rasm).

During the passage of this road, the following amount of soil is accumulated in front of the channel embankment:

$$V = S \cdot K_p \cdot \frac{L}{2} \qquad (6)$$

where S - is the cross-sectional surface of the excavation depth;

K_p - is the soil softening coefficient.

W_e - assume that the absolute character of the soil is normal and moves along the plane of the channel bank, where the ultimate tensile resistance is:

$$P_D = N(\sin\gamma + f\cos\gamma) \qquad (7)$$

here $N = q \cdot V \cdot f_1$ - normal pressure of the soil in the plane of the canal bank;

q – volumetric weight of the soil.

Putting the values of *N* and *V* in the above expression (7), we get the following.:

$$P_D = \frac{1}{2} q \cdot S \cdot K_p \cdot f_1 \cdot L(f + tg\varphi) \cdot \cos\gamma \qquad (8)$$

Using ABA1 in an oblique triangle.:

$$L = \frac{l}{\cos\gamma \cdot \sin\gamma(1 - tg\gamma \cdot tg\varphi)} \qquad (9)$$

here *l* is the size of the transverse displacement of the soil;

Substituting (8) into expression (5) and its values from equality L (9), we get the following from $tg\varphi$ the corresponding transformation:

$$P_D = \frac{q \cdot S \cdot K_p \cdot l}{2} \cdot \frac{(f + f_1) f_1}{f} \cdot \frac{(f + tg\gamma)}{\sin\gamma} \qquad (10)$$

The cross-section of the canal bank will have the shape of an equilateral triangle, taking into account the allowances for determining the transverse movement of the soil with the digger when forming the canal bank (1 - rasm) [5,6,7,8]. In this case, the displacement of the center of curvature of the cross-section of the canal bank can be written in the following form when the slope angle is changed:

$$l = l_1 + \Delta = \sqrt{\frac{S \cdot K_p}{2}} \cdot (\sqrt{ctg\lambda_2} - \sqrt{ctg\lambda_1}) + \Delta \qquad (11)$$

here λ_1, λ_2 - the slope angle of the forming canal bank, the widths formed by the digger and its wings, respectively;

Δ -. slope angle, variable from γ angle, range from 0 to 2.

Δ for a small value of , formula (11) can be written in the following form for the purpose of simplification:

$$l = \sqrt{\frac{S \cdot K_p}{2}} \cdot (\sqrt{ctg\lambda_2} - \sqrt{ctg\lambda_1}) \qquad (12)$$

changing $ctg\lambda_2$ in the formula to m2, taking into account that many canal diggers form the internal slope of the canal bank at an angle of 450, we put the value of l in expression (11). Bunda kanal qirg'og'ini hosil qilgichning tortish qarshiligi formulasi quyidagicha ko'rinadi.

$$P_D = \frac{q(\sqrt{m} - 1)(f + f_1)}{f} \sqrt{(\frac{S \cdot K_p}{2})^3 \cdot \frac{(f + tg\gamma)}{\sin\gamma}} \qquad (13)$$

Using expression (4), formula (13) can be written in the following form.

$$P_D = q(\sqrt{m_2} - 1)(\frac{f}{m_2 tgv} + \sqrt{1 - m_2^2 tg^2 v}) \frac{(f + f_1) f_1}{f} \sqrt{(\frac{S \cdot K_p}{2})^3} \qquad (14)$$

(13) It can be seen from the formula (13) that the function $\Phi(\gamma) = \frac{f + tg\gamma}{\sin\gamma}$ is the change in traction resistance from the installation angle of the plane forming the channel bank. The coefficient of friction of the working equipment to the soil at different values is depicted in the graph of this function (Fig. 3). [8,9,10,11].

It can be seen from this picture that in order to reduce the dimensions of the plane of the channel bank, its installation angle can be taken larger than the optimal value of 3....5^0 in the design in the direction of characterization. [12,13,14,15]. In this case, the traction resistance increases by less than 2%. Forming the bank of the channel, setting the flatness, γ_{opt} to determine the optimal value of the angle, we set the first number from $\Phi(\gamma)$ to γ equal to zero and calculate with respect to γ.

$$\frac{d[\Phi(\gamma)]}{d\gamma} = \frac{\dfrac{\sin\gamma}{\cos^2\gamma} - (f + tg\gamma)\cos\gamma}{\sin^2\gamma} = 0 \qquad (15)$$

here

$$\gamma_{opt} = arctg\sqrt[3]{f} \qquad (16)$$

According to formula (14), the required angle of the lower cut of the plane (plane) can be determined by knowing the optimal value of the lying angle of the internal slope of the canal bank and the angle of installation of the plane (plane) of the channel generator.

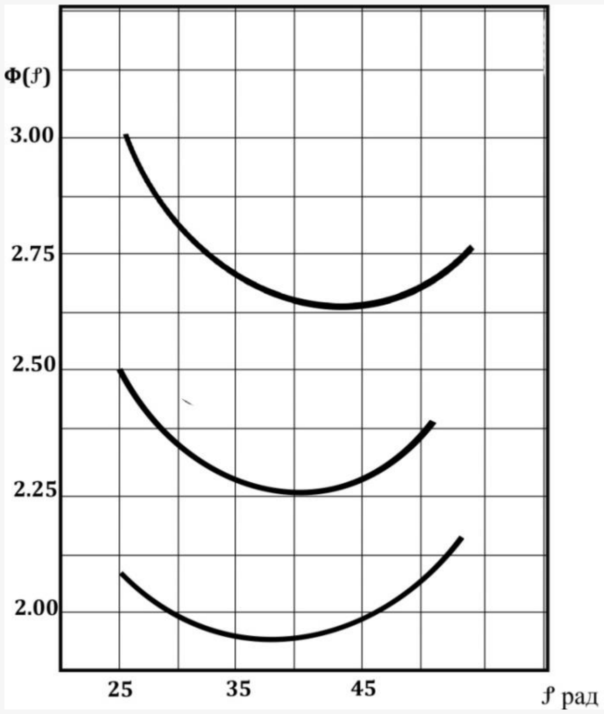
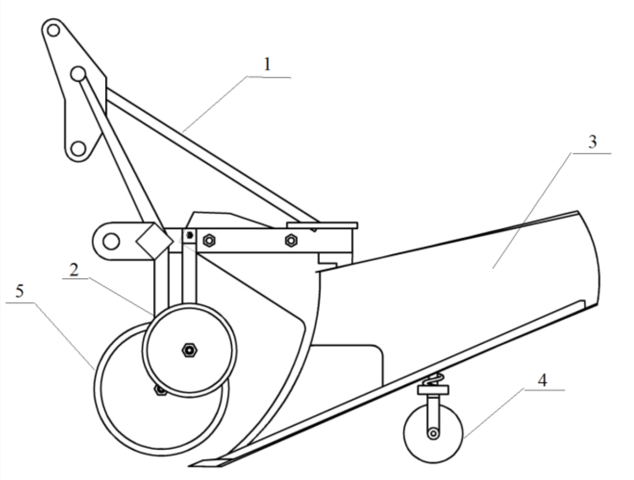


Fig. 3. Change of function 2 depending on 1:

1. f – 0,4; 2. f -0,6; 3. f-0,8.

Taking into account the above, it is necessary to improve the existing working equipment in order to reduce the coefficient of friction of the working equipment of the canal digger to the soil and ensure the quality of the created channel. Therefore, in order to increase the work efficiency of the temporary ditch digger, in order to improve the efficiency of the temporary ditch digger, in the front part of the dumper, in order to soften the soil, reduce the resistance, improve the quality of the soil fraction and slope, the right discs and a cage were installed to compact the bottom of the temporary ditch that is being created.



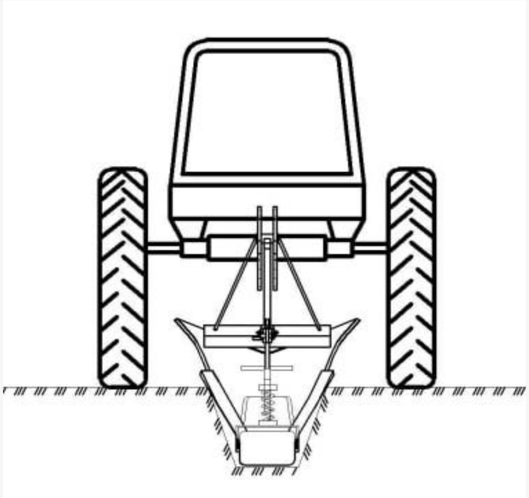


Figure 4. Scheme and operation of the improved digger.

1 – rama; 2, 5 – discs; 3 – tipper; 4 – densifier rink.

The energy-saving channel digger improved by our researches and the disks recommended by us can prevent the rapid failure of the working equipment blade when digging a temporary ditch, reduce fuel consumption by 12-15% and increase the productivity by 1.5 times.

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