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Energy-Efficient Vertical Segmentsimon Installed on Working Equipment to Increase the Efficiency of Cutting the Soil, Taking into According to the Working Conditions of Scrapers

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Abstract:
The article focuses on the importance of scrapers in pushing soil through scrapers, cutting soil in ditches and trenches and pushing it into dumps or dumps, laying soil in canals, dams and ditches, mining minerals and The importance of scrapers in the cutting and leveling of soil at high altitudes is also significant, as well as information on the use of improved energy-saving scrapers and formulas for determining the forces acting on them.

Keywords:
Scraper, bucket, microrelief, leveling, vertical blade, chamfer, side surface, ponashape, sheika, resource, winch, hydraulic drive.

A wide range of measures are used to achieve energy and resource efficiency in agricultural production in all sectors of the country, the development of machines with high productivity, high-quality processing and working bodies based on advanced technologies in the cultivation of agricultural crops. -Measures are being taken. The Action Strategy for the further development of the Republic of Uzbekistan for 2020-2021, including "the introduction of intensive methods in agricultural production, first of all, modern water and resource-saving agro-technologies, high-yielding rural areas Extensive use of agricultural machinery "[1].

Scraper is a periodic earthmoving machine used for digging the soil (groups I, II soils on their own, and groups III and IV soils, using additional tractors) and spreading them in layers. Scrapers are widely used to cut soil in ditches and trenches and push it into dumps.

With the help of scrapers, canals are built, soil is laid on dams, and mining operations are carried out. There are trailer, semi-trailer and self-propelled types of scraper equipment. The scraper equipment of the trailer scrapers has a two-axis running gear. In semi-trailer scrapers, the scraper equipment rests on a single-axle walking part, so part of the load is transferred to the traction. In semi-trailer scrapers, the scraper equipment rests on a single-axle walking part, so part of the load is transferred to the traction. Depending on the capacity of the bucket, scrapers can be small-capacity (3 or 4.5 m3), medium-capacity (7 or 8 m3) and large-capacity (9 m3 and larger).) are divided into species. The capacity of the trailer scraper bucket is as follows: 3; 4; 5; 8 (7); 10; 15 and 25 m3; self-propelled scrapers have a bucket capacity of 8, 10, 15, 25 and 40 m3.

When the unit is running, full engine power must be used to fill the scraper with soil. The scraper can only be filled with soil if the tractor moves in a straight line on the first drive. Then the tractor is loaded normally. This method of filling the bucket with soil is called the comb method (Fig. 1-d). Depending on the properties of the excavated soil and the size of the scraper, the thickness of the cut layer is 12-30 cm, the thickness of the shed layer is 15-30 cm. If the thickness of the cut layer is optimal, the length of the filling path of the bucket will be 15-25 m.

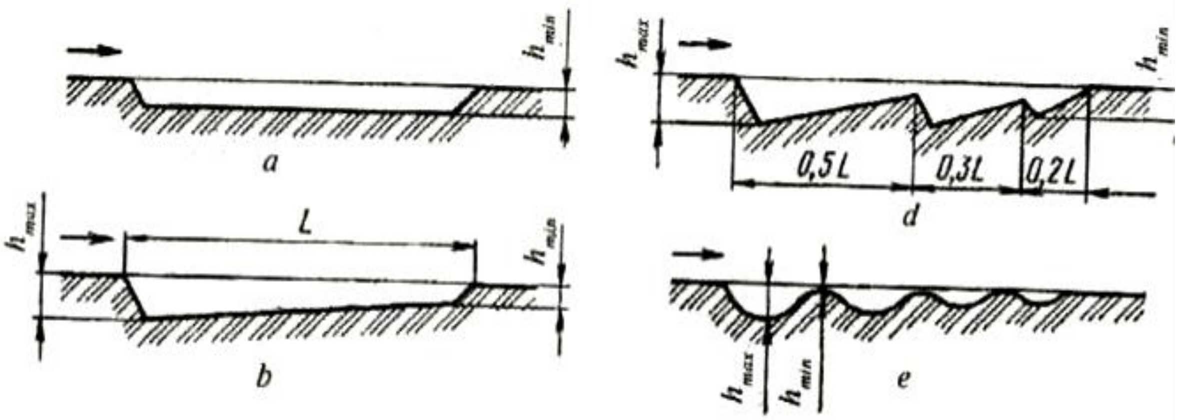

Figure 1. Methods of cutting soil with scrapers
a - of the same thickness; b – pona-shaped; d - comb; e - "climbing".

Scrapers work especially well on sandy and light sandy soils with optimal humidity, as the bucket is well filled with soil and completely loosened in this method. and in such cases, either the soil is loosened and then excavated, or the scraper is assisted to dig with additional tractors. This increases the economic aspects. To solve these problems, we recommend vertical blades mounted on the scraper bucket to reduce the overall resistance to the scraper bucket, and it has been achieved to reduce the resistance of the scraper to digging the soil into the scraper. The main function of this device is to cut the loosened and loosened soil vertically in front of the scraper bucket, reduce the overall resistance to falling into the scraper bucket, and improve the quality of the soil fraction and leveling. The following is a schematic of a scraper bucket with vertical softening blades proposed in Figure 2. The proposed device consists of the following:

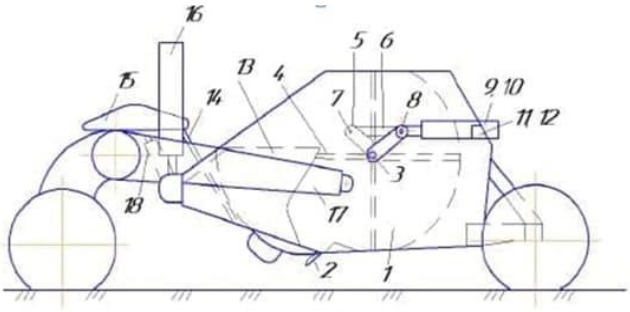

Figure 2. Scraper with vertical blades

1-bucket; 2-segment knife; 3-shaft; Limiter 4; 5,6-levers; 7.8 fingers; 9,10-turn hydraulic cylinders; 11,12-bracket; Cover 13, cover 14; 15- lever; 16-bucket hydraulic cylinder; 17 main frame; 18 cover hydraulic cylinder.

The following diagram shows the resistance of a softening blade mounted vertically to a scraper bucket and is based on the following formulas.

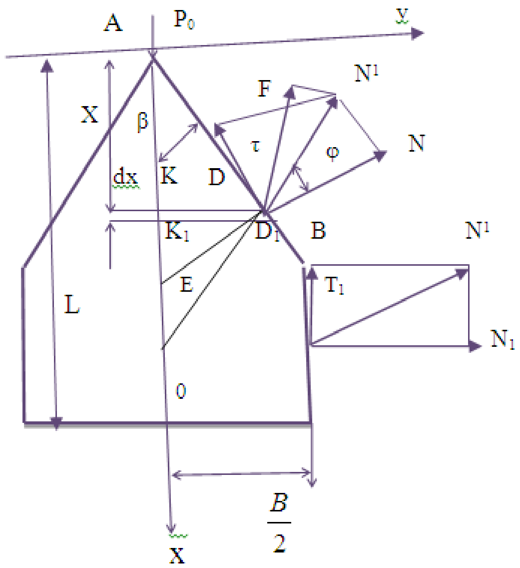

Figure 3. Schematic of the forces acting on the shear resistance of a vertical blade.

The shear force is as follows. (1)

$$P = N\frac{\sin(\alpha + \varphi_1 + \varphi_2)}{\cos\varphi_1 \cos\varphi_2}$$

Here: N is the average resistance of the layer.

@- cutting angle of the blade;

φ_1 and φ_2 — to the working height and compensation parts when cutting the soil with a knife

The sum of the resistances per unit area of the blade is as follows

$$p = p_L + 2F + T_1$$

P1- Cutting line resistance

Resistance in F-phase

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T1-blade surface resistance.

According to Pona's theory

$$F = \frac{\sin(\beta+\varphi)}{\cos\varphi} N$$

but $N = \sigma S_1 = \sigma \frac{b}{2\sin\beta}$

Here is the S-surface, σ- pressure acting surface

If we assume that $\sigma = \sigma_0$, then the specific pressure of the soil on the blade is constant, then the deformation of the soil is not taken into account.

The normal force in the unit of length of the chamfer is N

$$N = \sigma S_1 = \sigma \frac{b}{2\sin\beta}$$

The F-force is equal to the following than in the pona theory.

$$F = \frac{1}{2}\sigma_0 b \frac{\sin(\beta+\varphi)}{\sin\beta\cos\varphi} = \frac{1}{2}\sigma_0 b\left(1+\frac{tg\varphi}{tg\beta}\right) \qquad (2)$$

The force exerted on the blade $T_1 = N_1 tg\varphi$

In this case, N1 is the normal reaction force per unit area of the blade. Given the accepted condition.

$$N_1 = \sigma_0\left(l - \frac{b}{2tg\beta}\right)tg\varphi$$

Thus the quantitative resistance acting on the surface of the blade

$$T_1 = \sigma_0\left(l - \frac{b}{2tg\beta}\right)tg\varphi \qquad (3)$$

Given the formula (1), the specific resistance at shear can be written as follows.

$$p = p_l + \sigma_0 b\left(1+\frac{tg\varphi}{tg\beta}\right) + 2\tau_0\left(l - \frac{b}{tg\beta}\right)tg\varphi = \rho_l + \sigma_0(b + 2ltg\varphi) \quad (4)$$

Thus, there is pressure at point D located at X away from the Y axis

$$\sigma = c\left(\frac{DE}{AB}\right)^{\mu}$$

and elementary reaction

$$dN = \sigma DD_1 = c\left(\frac{DE}{AB}\right)^{\mu} DD_1$$

But from the triangles ADK and ADE the following emerges:

$$DE = \frac{xtg\beta}{\cos\beta} \quad AB = \frac{b}{2\sin\beta} \quad DD_1 = \frac{dx}{\cos\beta}$$

By substituting the values of DE, AB, and DD1 into the formula, we obtain the following.

$$dN_D = c\left(\frac{xtg\beta}{\cos\beta}\bullet\frac{2\sin\beta}{b}\right)^{\mu}\frac{dx}{\cos\beta} = \left(\frac{2x}{b}tg^2\beta\right)^{\mu}\frac{dx}{\cos\beta} = \frac{c}{\cos\beta}\left(\frac{2tg^2\beta}{b}\right)^{\mu} x^{\mu}dx$$

According to the knife theory, the generator of longitudinal elemental reactions at point D takes the following form.

$$dF = c\frac{\sin(\beta+\varphi)}{\cos\beta\cos\varphi}\left(\frac{2tg^2\beta}{b}\right)^{\mu} x^{\mu}dx$$

The sum of the longitudinal resistance in the chambers of the blade F is equal to the sum of the elementary components along the line AB.

$$F\int_A^B dF = c\frac{\sin(\beta+\varphi)}{\cos\beta\cos\varphi}\left(\frac{2tg^2\beta}{b}\right)^{\mu}\int_A^B x^{\mu}dx.$$

The x-coordinate along the edge of the blade varies within the following limits: x = 0 at point A, then B

$$x = \frac{b}{2tg\beta}$$

Thus,

$$F = c\frac{\sin(\beta+\varphi)}{\cos\beta\cos\varphi}\left(2\frac{tg^2\beta}{b}\right)^{\mu}\int_0^{\frac{b}{2tg\beta}} x^{\mu}dx$$

$$= c\frac{\sin(\beta+\varphi)}{\cos\beta\cos\varphi}\left(2\frac{tg^2\beta}{b}\right)^{\mu}\left|\frac{x^{\mu+1}}{\mu+1}\right|\int_0^{\frac{b}{2tg\beta}}$$

$$= c\frac{\sin(\beta+\varphi)2^{\mu}tg^{2\mu}\beta b^{\mu+1}}{\cos\beta\cos\mu b^{\mu}2^{\mu+1}tg^{\mu+1}\beta(\mu+1)}$$

After the changes, the final expression takes the following form:

$$F = \frac{1}{2(\mu+1)}cbtg^{\mu}\beta\left(1+\frac{tg\varphi}{tg\beta}\right)$$

Based on the above formulas, by determining the resistance forces acting on the vertical blade, the vertical cutting of this device using soft soil softening blades will reduce the resistance of the main bucket to pushing the soil.

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