CHOICE OF RISES OF WORKING BODIES OF THE CHISEL-CULTIVATOR

Adham Urishev.

Tashkent institute of irrigation and agricultural mechanization engineers, 39 Kari Niyaziy Street, Tashkent 100000, Uzbekistan

Aurishev69@mail.ru

Abstract. The article discusses a comparative study of the choice of the type of racks of the working bodies of the chisel-cultivator. In bench tests, each rack was mounted on a special frame; a static load was applied to them, simulating the resultant soil resistance forces. At each loading stage, the movement of the toe of the paw was measured. In addition, the agro-energy performance of the chisel cultivator with various stands was studied. According t the results of the study, a spiral elastic strut was chosen.

1. Introduction

One of the ways to increase the efficiency and productivity, as well as the reliability of chisel tools in pre-sowing tillage is to improve the design of their working bodies. It should be noted that in the last period there have been significant changes in the energy base of agriculture, energy-saturated high-speed tractors have been created and are increasingly being used. At the same time, individual agricultural implements and their working bodies remained the same, this applies to the chisel cultivator. In the cotton growing zone, chisel cultivators are the main tools for loosening the soil after washing and reserve irrigation.

2. Methods

Recently, both in our country and abroad, the working bodies of chisel cultivators and other tillage machines are equipped with spring-safety or elastic stands. According to many researchers, the use of such racks reduces the traction resistance of the gun, provides the best quality indicators of its work, eliminates the breakdown of the working bodies. [1-6]

3. Resultsand discussion

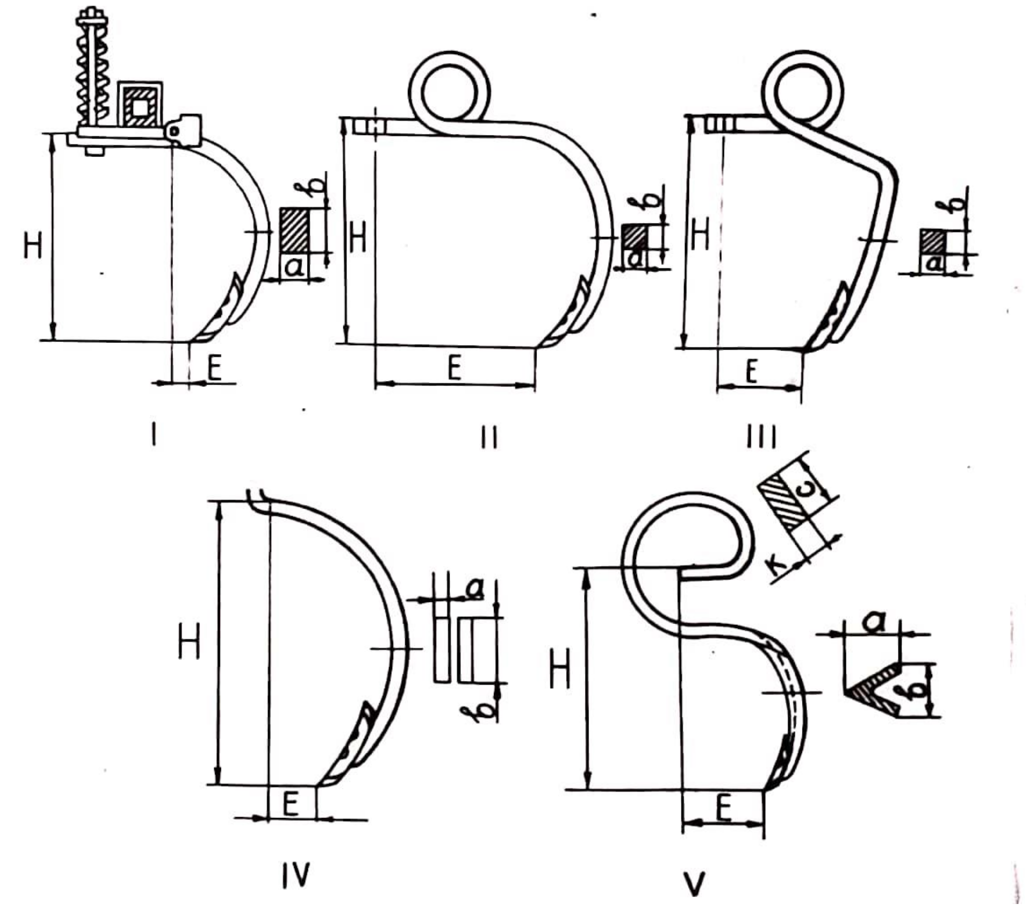
Despite this, the working bodies of the cotton chisel cultivators ChKU-4 and ChKU-4A still have rigid racks.

In this regard, we conducted a scientific, technical and patent review of the leading countries producing chisel guns, and the most promising options for elastic struts and suspensions were selected based on its results (Pic. 1 and Table 1)

I. Spring-safety suspension of the cultivator KPE-3.8;
II. Spiral elastic stand of cultivator KChP-5.4;
III. Spiral elastic stand of the VISXOM design;
IV. C-shaped rack of a cultivator KPS-4
V. S-shaped rack of a spring cultivator NZ-97 from Vaderstad (Sweden).

These racks passed comparative bench tests and laboratory field tests in order to select the most rational of them for the working bodies of cotton chisel cultivators.

In bench tests, each rack was mounted on a special frame; a static load was applied to them, simulating the resultant soil resistance forces. At each loading stage, the displacements of the toe of the paw (working body) were measured horizontally “e” and vertical “h” (Pic. 2).



v

Pic. 1 Types of the studied racks of the working bodies of the chisel-cultivatorv.

Using the data obtained, the stiffness of the racks was determined and their elastic characteristics were constructed in the form of graphs expressing the horizontal dependence of the toe of the paw on the load (Pic.). It should be noted that to ensure the oscillatory process of the working body and the uniformity of the depth of tillage, the rigidity of the rack should be in the range of 15-20 N / mm, and the movement of the tip of the working body in the vertical direction under the action of the working load Visage, which is equal to 0.8..1,2kN / 1 /, should not exceed + 2cm.

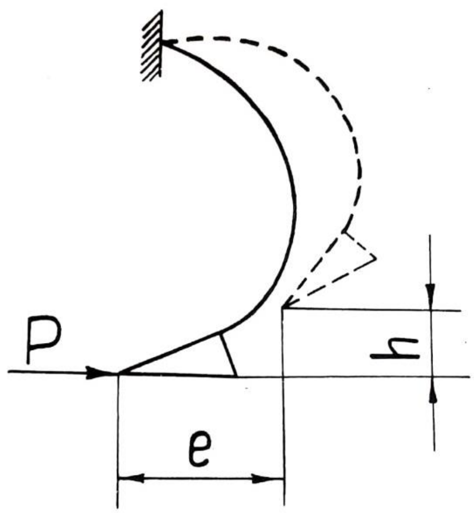
Table 1.

Parameters of elastic struts and spring-safety suspension.

№	Options	Names	Weight G, kg	Sizes, mm			
				H	E	a x в	c x к
1	1	Spring-safety suspension of the cultivator KPE-3.8	27,5	560	180	55*25	-
2	2	Spiral elastic stand of a cultivator KChP-5,4	16,4	660	400	30*30	-

3	3	Spiralelasticstand “VISXOM”	15,4	630	270	30*30	-
4	4	Spring C-shaped rack of a cultivator KPS-4	4,6	460	50	40*8	-
5	5	Spring S-shaped rack of a cultivator of NZ-9,7	4,1	300	260	23*9	45*9

Pic. 2 Diagram for determining the movement of the sock of the working body.



Analysis of the results of bench tests showed the following. The spring-loaded safety suspension (Fig. 3, curve I) has a two-stage characteristic. In the load range up to 1.2 kN, its rigidity decreases from 67 to 21 N / mm, and with a further increase in load to 1.6 kN, it increases to 24 N / mm. In the working load range, the rigidity of this rack is 20-25 N / mm. With increasing load, the paw deepens, i.e. her toe moves up. At the maximum working load, the paw deepening was 15 mm, which is permissible by agrotechnical requirements. The spiral elastic struts of the cultivator KChP-5.4 (curve II in Pic. 3) and VISKHOM (curve III in fig. 3) have a straight elastic characteristic. Their longitudinal stiffness is almost the same and is respectively 15.2 ... 17.4 and 14.3 ... 16.7 N / mm. With an increase in load on both legs, the paw deepens. However, at the KCHP-5.4 cultivator rack, the paw deepening is twice as much as at the VISXOM rack, and already at a working load of 0.8 kN it exceeds the permissible limit. At the “VISXOM” rack in the working load range (0.8 ... .1.2 kN), the recess of the paw is 10 ... .16 mm, which is within acceptable limits. The C-shaped strut also has a curvilinear characteristic (curve IV in Fig. 3). In the load range up to 1 kN, its rigidity decreases from 22 to 17 N / mm. With an increase in load, the paw deepens, i.e. under the action of the workload, the toe moved downward, this entails unevenness of the working depth and an increase in traction resistance.

Based on this, the considered stand can also be considered unacceptable for the chisel cultivator cultivating paws. The S - shaped stand has a slightly pronounced curvilinear characteristic (curve V in Pic. 3) and low rigidity (10 ... .13 N / mm). With an increase in load, the paw is deepened deeply and its deepening significantly exceeds the permissible limit over the entire range of the working load. Therefore, this stand for chisel cultivator is not acceptable.

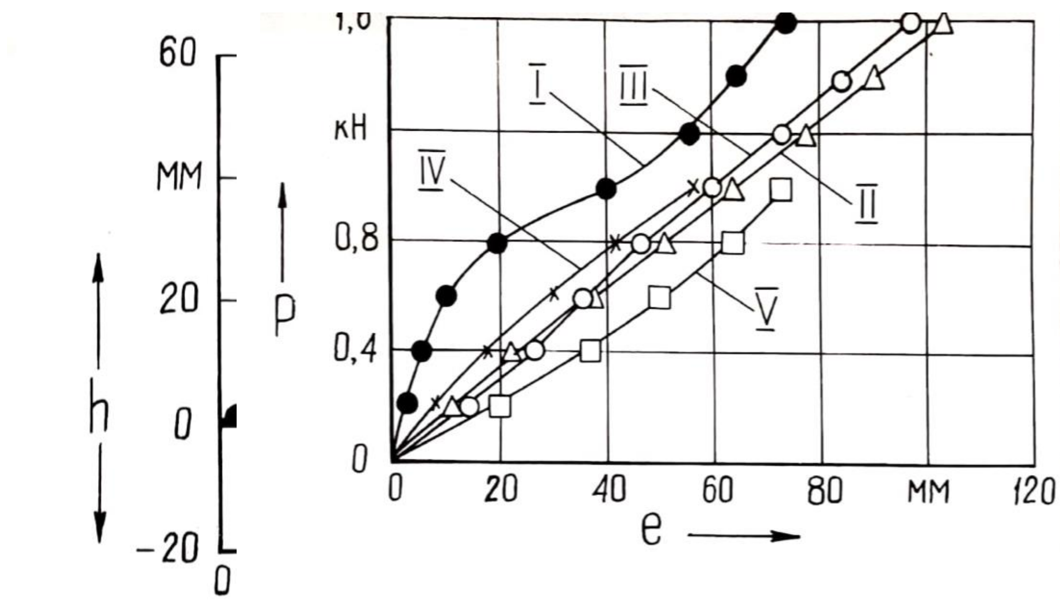
Thus, the research results show the most acceptable for the cotton chisel-cultivator are the VISXOM spiral elastic stand and the spring-safety suspension.

In the future, the agro-energy indicators of these racks were compared with a rigid one.

The experiments were conducted on the fields of the experimental farm SAIME. The soil moisture in the horizon 0 ... .20 cm was 16.11%, and the hardness was -2.08 MPa. The study was carried out on a installation that allows you to mount various working bodies. The unit was aggregated with a MTZ-80 tractor at speeds of 1.5 ... 3.3 m / s. The working bodies were installed on all options to a depth of 18 cm with an inter-track of 150 mm.

The test results are presented in Table 2. For all working bodies, with an increase in the speed of movement, the quality of crushing of the soil improves, i.e. in the loosened soil layer, the number of agronomic valuable fractions with sizes less than 50 mm increased, and with sizes greater than 50 mm decreased.

Pic. 3: Elastic characteristics of the struts (a) and kinematics of the working body (b): curves I; II; III; IV; V correspond to the types of racks in Pic. I



Pic. 3: Elastic characteristics of the struts (a) and kinematics of the working body (b): curves I; II; III; IV; V correspond to the types of racks in Pic. I

This is because the impact force of the working bodies on the lumps of soil increases and they are crushed into smaller particles. The best quality of loosening the soil was provided by working bodies on spiral elastic stands. The yield of agronomic valuable fractions after the passage of the working bodies on these racks is 10.4 ... .13.3% higher than that of serial hard racks. The working bodies on the spring-safety suspension also provides, in comparison with the rigid, the best quality of crumbling soil. However, it is somewhat inferior to the working bodies on an elastic-spiral strut.

According to the uniformity of the depth of tillage between the compared options, approximately the same indicators were obtained. Some decrease in the depth of tillage with an increase in the speed of movement can be explained by an increase in the traction resistance of the implement. From table 2 it is seen that with an increase in the speed of movement of all working bodies, traction resistance increases. However, at the same speed at the depth of processing, the specific traction resistance of the working body on the elastic spiral strut is 17.9 ... 24.7% less than that of the working body on a rigid strut. This is due to the fact that during operation, the elastic stand makes forced oscillations due to variable soil resistance. affects the nature of the process of soil destruction and leads to a decrease in traction resistance.

Table 1.

№	Speed of movement m / s	Uniformity of depth of processing		Contentfraction (%) dimensions, mm			Specific traction resistance, kN / m
		M cf,sm		> 50	50-10	< 10	
Spiral elastic							
1	1,51	18,41	1,58	12,73	34,26	53,01	5,9
2	2,02	18,12	1,77	9,73	34,58	55,69	6,2
3	2,94	17,84	1,89	7,2	35,09	57,71	6,8
4	3,35	17,48	2,06	6,02	35,63	58,35	7,4
Spring safety							
1	1,51	18,13	1,64	19,09	33,12	51,79	6,5
2	2,02	17,83	1,78	13,63	34,44	51,93	7,4
3	2,94	17,3	1,83	10,42	35,79	53,79	8,5
4	3,35	16,87	1,90	6,08	37,37	57,55	9,2
Series Rigid (Control)							
1	1,51	19,29	0,99	23,8	33,79	42,41	7,8
2	2,02	18,76	1,25	23,04	35,52	43,44	8,7
3	2,94	18,6	1,37	18,48	36,03	45,49	9,2
4	3,35	18,19	1,51	15,11	36,5	48,39	9,9

4.Conclusions

In addition, in the process of work due to the vibration of the elastic strut, a compacted core is not formed in front of the working body and there is no sticking of the paw soil and clogging by the plant residues of the strut, which helps to reduce its traction resistance. The indicators of the spring-safety suspension are between the serial rigid and elastic spiral strut.

Thus, on the basis of the conducted studies, it can be argued that the best quality of soil cultivation with minimal energy consumption is ensured by installing the working bodies of the chisel cultivator on spiral elastic stands. In the future, it is necessary to study the layout of the loosening paws on elastic struts on the frame of the gun.

References

[1] A.Kh.Tsesnieks On the issue of planar dynamometry of spring teeth of cultivators.// Mechanization and electrification of agriculture.-Riga, 1983.-Issue 8 (15) .- P. 24-33.

[2] A. S Kushnarev. Mechanical and technological foundations of the process of the impact of the working bodies of tillage machines and implements on the soil: Diss ... Doctor of Technical Sciences. Chelyabinsk, 1982.-329c.

[3] V.P Bazarov. An additional elastic element and its effect on an elastic suspension // Design and production technology of agricultural machines.-Kiev: Technique, 1980.-Issue 10.-S.9-10

[4] I.V Ignatenko. Generalized dynamic model of the interaction of the working body of tillage machines with soil. Complex mechanization and automation of agricultural production.-Rostov-on-Don, 1985.-P.57-66

[5] A. A Zavrajnov. An approximate method for determining the displacements of an elastic rod under the action of a concentrated load // Studies of the working bodies of machines for cultivating and harvesting fruit-bearing crops and grapes (Collection of scientific papers. NPO VISXOM) .- M., 1987.- S.110-116.

[6] A. A Zavrazhnov. Models and methods for solving the problem of the movement of an elastically fixed working body in the soil environment Research and development of tillage and sowing machines (Collection of scientific papers by NPO VISXOM) .- M., 1985.-63-8

[7] A. A.Zavrajnov Justification of the methods for evaluating and calculating the parameters of elastic stands of chisel cultivators: Abstract. diss ... candidate of technical science.- M., 1988.-15 p.T. Akhmedhojaev

[8] T. S. G. Beglov I.F., Glovatsky O.Ya., “Analysis of fault diagnosis systems for pumping units,” 2001, pp. 61–65.

[9] M. Mamajonov, D. R. Bazarov, B. R. Uralov, G. U. Djumabaeva, and N. Rahmatov, “The impact of hydro-wear parts of pumps for operational efficiency of the pumping station,” in *Journal of Physics: Conference Series*, 2020, vol. 1425, no. 1, doi: 10.1088/1742-6596/1425/1/012123.

[10] T. T. N. and I. N. M., “Evaluation of operational and energy regimes of large pumping stations,” Tashkent, 2010.

[11] N. I. and M. M. Eduard Kan, “The change in the efficiency factor of the pumping unit with a frequency converter,” 2019, vol. 05008, p. 5008.

[12] Q. Z. Liu, W. T. Su, X. Bin Li, and Y. N. Zhang, “Dynamic characteristics of load rejection process in a reversible pump-turbine,” *Renew. Energy*, vol. 146, pp. 1922–1931, Feb. 2020, doi: 10.1016/j.renene.2019.08.038.

[13] F. Shaazizov, B. Uralov, E. Shukurov, and A. Nasrulin, “Development of the computerized decision-making support system for the prevention and revealing of dangerous zones of flooding,” in *E3S Web of Conferences*, 2019, vol. 97, doi: 10.1051/e3sconf/20199705040.

[14] W. Yu-qin and D. Ze-wen, “Influence of blade number on flow-induced noise of centrifugal pump based on CFD/CA,” *Vacuum*, vol. 172, Feb. 2020, doi: 10.1016/j.vacuum.2019.109058.

[15] R. Tao and Z. Wang, “Comparative modeling and analysis of the flow asymmetricity in a centrifugal pump impeller at partial load,” *Proc. Inst. Mech. Eng. Part A J. Power Energy*, vol. 234, no. 2, pp. 237–247, Mar. 2020, doi: 10.1177/0957650919851921.

[16] C. Wang, Y. Zhang, H. Hou, and Z. Yuan, “Theory and application of two-dimension viscous hydraulic design of the ultra-low specific-speed centrifugal pump,” *Proc. Inst. Mech. Eng. Part A J. Power Energy*, vol. 234, no. 1, pp. 58–71, Feb. 2020, doi: 10.1177/0957650919850420.

[17] J. M. C. Cubas, H. Stel, E. M. Ofuchi, M. A. Marcelino Neto, and R. E. M. Morales, “Visualization of two-phase gas-liquid flow in a radial centrifugal pump with a vaned diffuser,” *J. Pet. Sci. Eng.*, vol. 187, Apr. 2020, doi: 10.1016/j.petrol.2019.106848.

[18] R. M. Perissinotto, W. Monte Verde, C. E. Perles, J. L. Biazussi, M. S. de Castro, and A. C. Bannwart, “Experimental analysis on the behavior of water drops dispersed in oil within a centrifugal pump impeller,” *Exp. Therm. Fluid Sci.*, vol. 112, Apr. 2020, doi: 10.1016/j.expthermflusci.2019.109969.

[19] I. N. M. and T. T.N., “Factors affecting the operational and energy mode of operation of pumping stations,” in *Materials of the International scientific-practical conference “Problems of complex arrangement of techno-natural systems”, part 1 “Land reclamation, recultivation and protection of lands,”* 2013, vol. 215–220, pp. 215–220.

[20] L. G. V.Nenja, S.Khovanskyy, “Providing of the law of pumping station parameters’ regulation by means of throttling elements,” *Proc. Eng.*, pp. 175–181, 2012.