UDC 621.878.23

Innovative ways to improve machines for preliminary work given the needs of the modern construction industry

Mykola Prystailo [1], *Maksym Balaka* [2], *Valentyn Mozharivskyi* [3], *Volodymyr Drachuk* [4], *Ihor Honta* [5]

[1,2,3,4] Kyiv National University of Construction and Architecture,
31, Povitroflotsky Ave., Kyiv, Ukraine, 03037,
[1] prystailo.mo@knuba.edu.ua, https://orcid.org/0000-0003-3151-4680,
[2] balaka.mm@knuba.edu.ua, https://orcid.org/0000-0003-4142-9703,
[3] kompass@ukr.net, https://orcid.org/0009-0004-0402-8235,
[4] vdv2882@gmail.com, https://orcid.org/0009-0006-2963-8675,
[5] honta_ip-2022@knuba.edu.ua, https://orcid.org/0009-0002-4441-8049

Received: 10.10.2023; Accepted: 10.11.2023
https://doi.org/10.32347/gbdmm.2023.102.0402

Abstract. The bulldozer-ripper is the main machine during preliminary work. The creation of high-performance machines is carried out in two directions: the production of fundamentally new working elements and machines based on the use of fundamental scientific achievements and the improvement of existing working elements, and traditional type machines that are in operation.

The creation of working elements for ripper-picks is a perspective development direction of machines designed for ripping frozen and hard soils. They would make it possible to significantly increase the productivity of ripping work through the rational use of the base machine traction force. We applied the superposition principle of the impact on the working medium of several factors concurrently for this, such as static and dynamic loads, through the energy accumulation and its subsequent use to create a high-speed power impulse on the cutting edge to ensure the preliminary formation of the compressed zone in the soil massif. This will lead to the power intensity reduction of the static load on the soil element separation.

Keywords: bulldozer-ripper, power intensity reduction, superposition principle, machines for preliminary work.

INTRODUCTION

The effectiveness of the reconstruction and capital construction of industrial and civil projects depends on the technology perfection and the mechanization level of construction works. Preliminary works for ripping hard and frozen soils are the most labor-intensive works in construction [1–5].

Works to the planning of sites, the arrangement of the foundation pits and trenches became the most widespread in residential civil and industrial construction in winter conditions. The volumes of these works are constantly increasing and currently amount to 16 billion m^3 per year. The number of workers to perform preliminary and earthworks is 9.3 % of the total number of workers in construction, particularly to perform preliminary work – 2.9 %. The main volumes of earthworks are performed by single-bucket hydraulic excavators (38.2 %), bulldozers (29.7 %), scrapers (15 %), multi-bucket excavators (6 %), another building machine (11.1 %) [6–8].

More than 140,000 hydraulic excavators, 42,000 scrapers, and 130,000 bulldozers are used in our country, for which preliminary (ripping) work is required in winter.

Bulldozer-rippers take the leading place when performing preliminary work. They perform a significant range of works in the development of pits, construction of highways and railways, emergency-rescue operations, etc.

PURPOSE OF THE PAPER

The purpose of the paper is to substantiate the choice of perspective directions for the creation of highly effective ripper-picks.

RESEARCH RESULTS

Traditional designs of rippers and their elements, and as new constructive decisions, are most often used to perform ripping works in construction (Fig. 1–2). This allows effective use of the machine traction force and dynamic phenomena that occur during soil cutting.

Fig. 1. Designs of working elements for multi-toothed ripper-picks

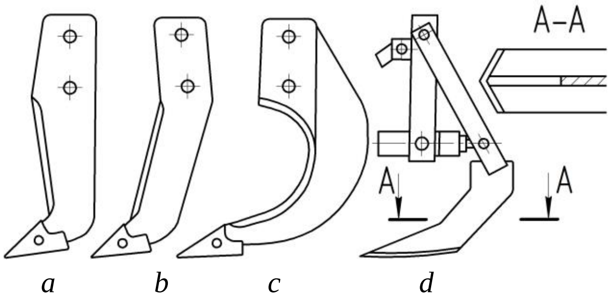

Fig. 2. Designs of working elements for ripper-picks with one tooth: (*a*) straight; (*b*) half-bent; (*c*) curved; (*d*) in the form of ploughshare

However, they do not satisfy the operation conditions of rippers for these reasons: they rip the soil in one pass to the 0.3…0.35 m slight depth for a ripper of the 100 kN traction class at the 140…160 hits frozen loam density by means of density meter, the ripped soil has a large fragmentation, which makes it difficult to use excavators in the future [6, 9].

A wide range of various tip designs with improved shape increased durability, and wear resistance have been developed to improve the single-toothed working elements of rippers and to eliminate their defects. They are distinguished by the front edge shape [1, 2, 10]: straight (Fig. 3, *d*); concave (Fig. 3, *f*); with a protrusion on the front and back faces (Fig. 3, *g*), made in the triangle form with a variable sharpening angle, which decreases from the cutting side of the tip by No. 723060 author's certificate and with notches, which located along the entire length of the front and back faces by No. 823515 author's certificate, (Fig. 3, *h*); bimetallic (Fig. 3, *i*), in which the cutting part is forged from a bimetallic sheet to ensure work on highly abrasive soils; by No. 823284 author's certificate with a wear-resistant overlay on the front face (Fig. 3, *k*).

The presence of such additional elements leads to the formation of stress concentrators, which in turn create significant alternating dynamic loads which active on ripping equipment elements and on the basic tractor. Vibrations in the operation of machines are undesirable as a rule. They deteriorate the processing quality, increase tool wear, and lead to accidents and failure of devices and equipment (in particular, due to the self-unscrewing of fasteners).

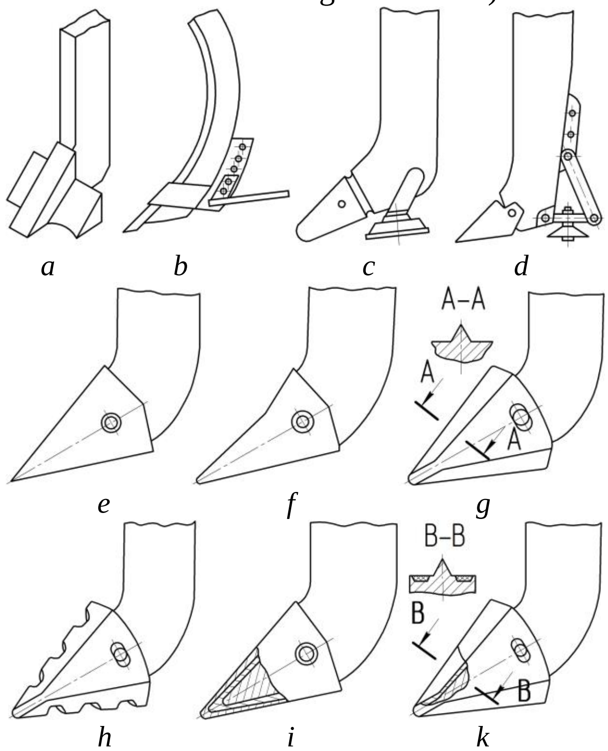

Fig. 3. Part designs of working elements for ripper-picks: (*a*) wedge type; (*b*) with height control; (*c*) disc type; (*d*) with location control of disc and tips; (*e*) direct; (*f*) concave; (*g*) with protrusion; (*h*) with notches; (*i*) bimetallic; (*k*) with wear-resistant overlay

They also cause a high level of vibration in the workplace driver, which generally worsens the productivity of the soil-ripping process.

Such vibrations would be expedient to accumulate and used to ensure the high speed of purposeful blows of cutting elements [11, 12].

The constructive ripper decision No. 1057635 author's certificate (Fig. 4) involves increasing the operation durability by reducing dynamic loads on the front 1 and back 2 working teeth. The ripping resistance is minimal during the ripper operation at the moment when the front working tooth 1 makes a chip. At this time, the back working tooth 2 creates a stress state in the soil, the ripping resistance is maximum in this case. Thus, the operating teeth work by alternating the chip of the soil with the creation of the stress state in it. This provides a reduction in dynamic loads on the working element and the base machine and increases its durability.

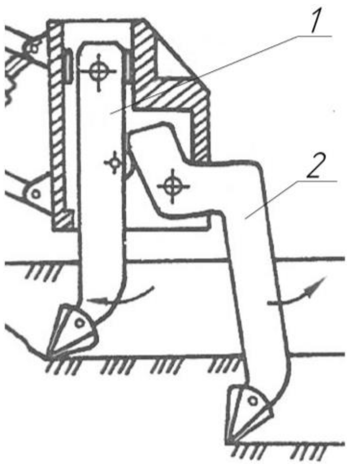

Fig. 4. Constructive ripper decision

This design takes into account the alternating nature of the soil resistance to cutting, but does not accumulate energy.

The elimination of unwanted vibrations led to the creation of a vibratory technique based on the purposeful use of vibrations. Vibrating machines have the ability to obtain high instantaneous speeds and accelerations with minor displacements as a result of the movement periodicity of the working element. The operation of the working element becomes more intensive due to this. So, an important direction of rippers improvement is modernization, which involves the amortization of loads by No. 927916 author's certificate (Fig. 5).

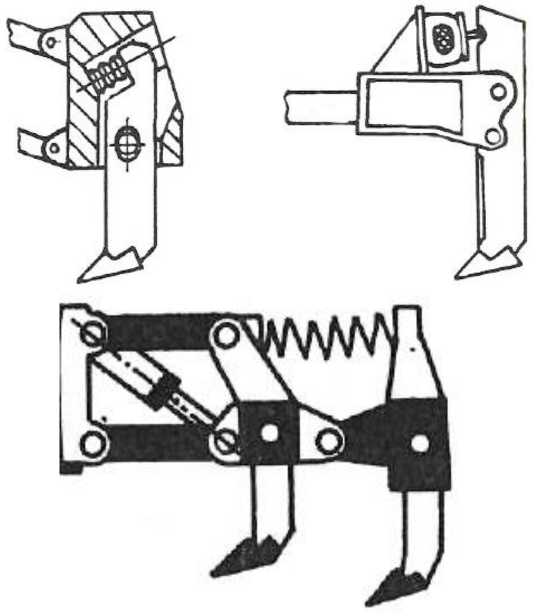

Fig. 5. Improvement of suspensions for ripper-picks with load amortization

The additional energy of the blow and the vibration impact by No. 658238 author's certificate (Fig. 6) is used to activate the ripping process with attached rippers at the modern performance stage of earthworks.

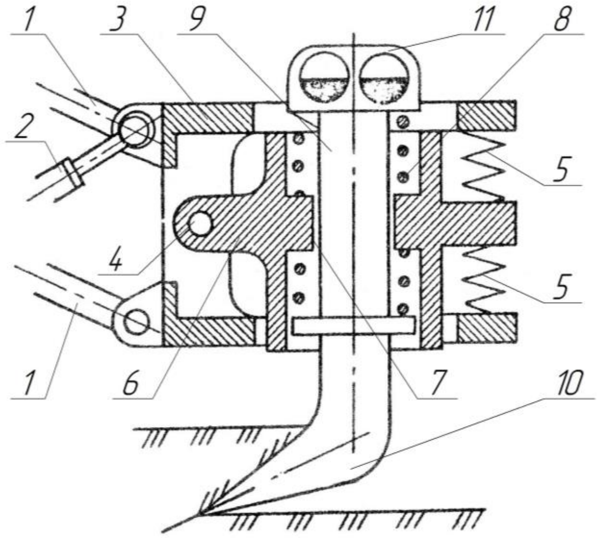

Fig. 6. Working element of the vibration ripper with parametric resonance

Designs with additional drives have a general defect: elements, in particular joints, fail prematurely due to the large mass of sections.

The invention by No. 1465508 author's certificate (Fig. 7) constructively allows the oscillation of only the small mass cutting plate, but there is no energy accumulation. A hydraulic motor powers the drive.

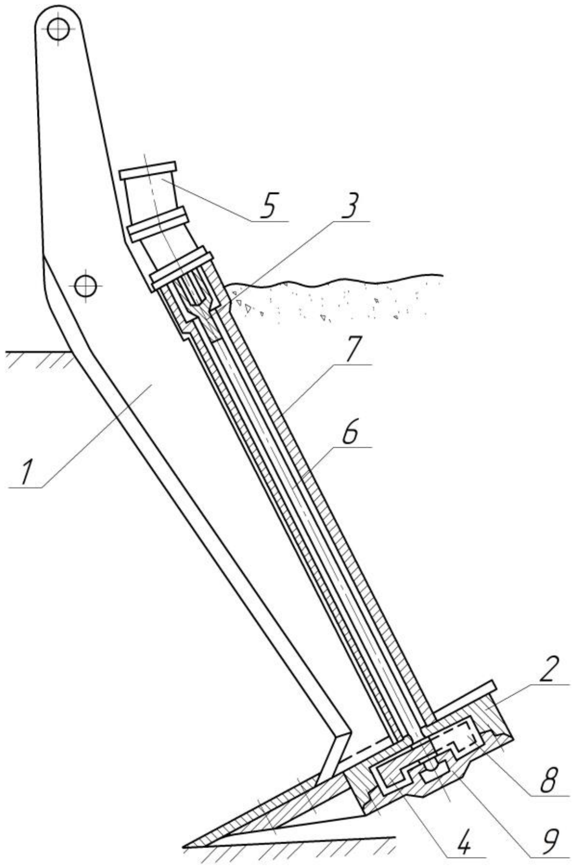

Fig. 7. Vibration earthmoving working element

It has been established that the use of directional vibrations of a specially selected frequency and amplitude improves the soil-cutting process quality, contributes to complex automation and mechanization of labor-intensive processes, and increases labor productivity and safety [13–15]. Vibration machines make it possible to carry out such technological operations, which are impossible to perform with ordinary machines.

The use effectiveness of vibrations has been proven in numerous examples. Vibrations of infrasound and sound frequency (to 5,000 Hz) have recently been widely used in road and mountain construction.

The analysis of the existing mounted ripper-picks and technical proposals to improve their designs and to increase the efficiency of the development process of hard and frozen soils shows that a perspective direction for the improvement of mounted rippers is the creation of new highly effective working elements. In particular, those that ensure a high speed of the soil destruction process without the use of additional energy [3, 10, 14, 16].

The considered design variants of the working elements for ripper-picks differ among themselves in the constructive decision, shape, and additional drive. This allows us to conclude the need to research and determine the rational parameters of the working elements for rippers. In particular, tips with elastically deformed executive elements make it possible to accumulate the energy of dynamic actions and use this energy for useful purposes. This is due to the creation and production of basic tractors by large unit capacity with 500…600 kW capacity basic engines. The traction force of such machines is sufficient for ripping soils of almost arbitrary strength without using additional energy. The creation of elastically deformed working elements reliable in operation for their use in the design of rippers is an actual problem [13, 17, 18]. This would ensure the accumulation of potential energy during soil compaction with transformation into kinetic energy and direct it into the soil massif at the right moment in time.

Similar problems are solved by the fact that the working element of the earthmoving machine has a plate made of elastic material with an unfastened section of length L, which is determined by equation

$$L = \sqrt[3]{\frac{xEc^3 b}{2P}},$$

where x – plate deflection; E – elastic modulus of material from which the plate is made; c – plate thickness; b – plate width; P – force of the soil resistance to destruction.

An unsecured section with the cutting edge is introduced into the soil massif at the time of operation, where it forms leading cracks [11].

The working element of the earthmoving machine (Fig. 8) consists of rack 1 and tip 2 set on it with pin 3. An element of elastic material cantilever fixed on the lower plane 4 of tip 2, then plate 5, which has an unfastened section 6 of L length. The upper face 7 and the back face 8 of the unfastened section 6 create the cutting edge 9. The upper face 7 with the front face 10 of the tip 2 creates the frontal surface 1 of the working element.

ISSN(online)2709-6149. Mining, constructional, road and melioration machines, 102, 2023, 49-57

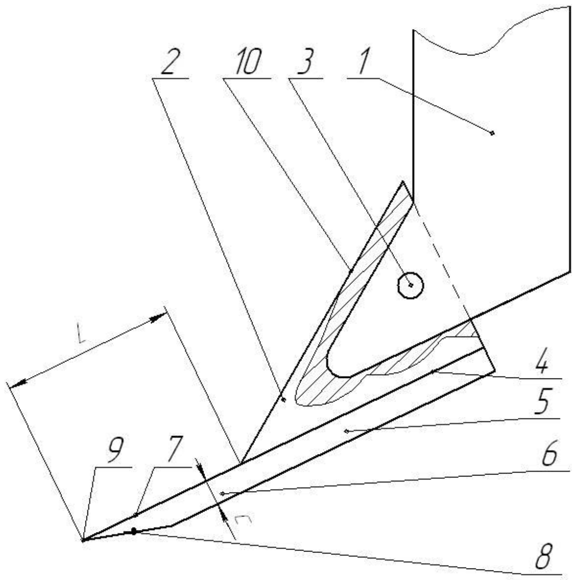

Fig. 8. Working element of earthmoving machine

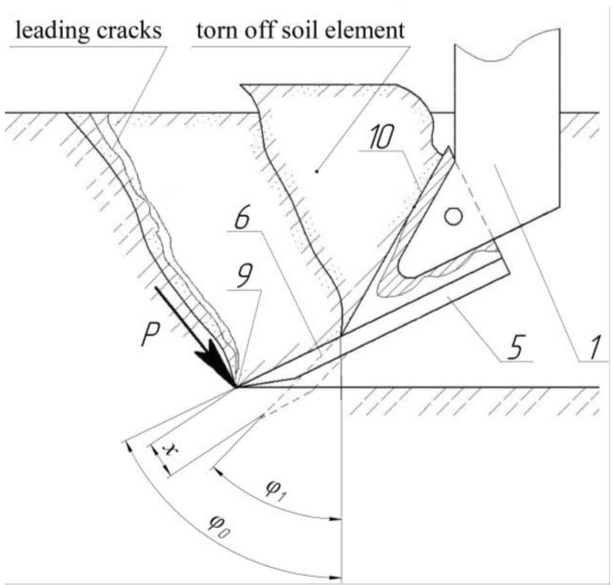

Fig. 9. Operation scheme of working element

The working element of the earthmoving machine operates as follows. The force of soil resistance to cutting P acts on the unsecured section 6 and bends it to an angle φ_1 (Fig. 9) when cutting edge 9 interacts with hard soil. As a result, it elastically deforms and accumulates potential energy. The soil is crumpled by the unfixed section 6 and the front face 10 (the frontal surface 11) when the working element is further inserted into the soil. As a result, the first soil element is separated. The force of soil resistance to cutting P goes to zero at this moment. As a result, the unfastened section 6 tries to take the initial position $\varphi_1 = \varphi_0$ due to elastic forces, and the potential energy turns into the kinetic energy of the section 6 movement. The unfastened section 6 with the cutting edge 9 is introduced into the soil massif, where it forms leading cracks. The already detached element of the soil is removed by the front face 10 to the bottom surface of the face. The unsecured section 6 under the action of the soil resistance force to cutting P is bent again, where it accumulates potential energy. The process then proceeds cyclically.

The proposed design has significant differences compared to known decisions, and thanks to them, the new positive effect is achieved, that expressed to increase operation productivity with a simultaneous decrease in energy consumption to ensure the technological process.

The next recommendation for constructive improvement is based on the task to increase operation productivity.

The inertial working element of the ripper contains significant changes, since new signs do not coincide with previously known signs. The tip has a cutting plate, where the back part is made in step form. The upper part rests against the body, which can move freely in the tip cavity, where the body mass is much larger compared to the cutting plate mass. The task is solved by the fact that the working element tip of the ripper has a moving mass that performs inertial blows on the cutting-edge plate [19].

The inertial working element of the ripper can be used in those cases when it's necessary to destroy frozen soils.

The inertial working element of the ripper (Fig. 10) consists of rack 1 and tip 3 set on it with pin 2. The latter has a wedge-shaped case 4, which has the mounting eye 5 with fixing hole 6, the front 7 and lower 8 surfaces, which has the «swallow tail» form 9, where the cutting plate 10 is inserted, which has the «swallow tail» protrusion 11 on top. The bush 12, whose surfaces are equidistant surfaces of the groove 9, made of anti-friction material, is inserted into the groove 9 between the plate protrusion 10. The cutting plate 10 has the lower surface 13 and the front inclined surface 14, which form a cutting edge 15 at the intersection. Step 16 is made in the back part of plate 10, where the upper part has the ability to rest against cylinder 17, and the lower part has the ability to go beyond the back dimension of case 4. The cylinder 17 is contained in the cylindrical hole 18 made in case 4. A slot 19 for step 16 and a thread, into which plug 20 is screwed, are made in back part of cylinder 17.

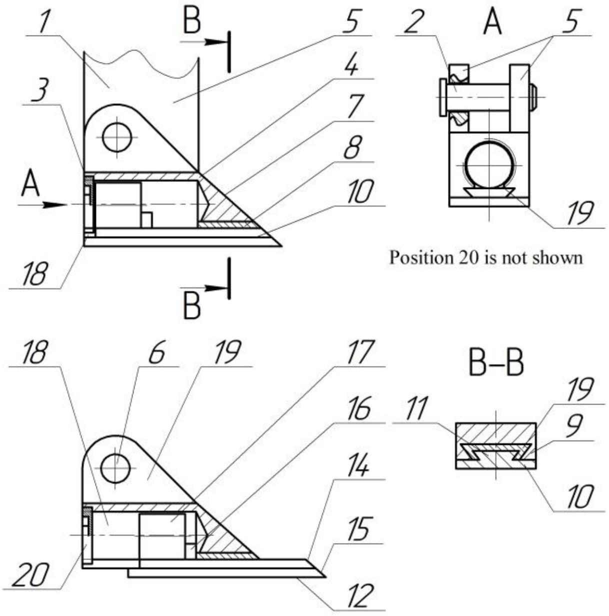

Fig. 10. Inertial working element of ripper

The inertial working element of the ripper operates as follows.

The soil resistance force to cutting acts on the cutting edge 15 and pushes the cutting plate 10 back together with cylinder 17 (see Fig. 10) when the inertial working body of the ripper 3 interacts with the frozen soil. The soil is crumpled by the frontal 7 and front inclined 14 surfaces when the tip is further inserted in him. As a result, the soil element is separated. At this moment, the soil resistance to cutting decreases significantly and then increases again. The working element moves in jerks at a non-constant speed. As a result, cylinder 17 at the movement deceleration of the working element continues to move inertial and pushes forward the cutting plate 10 with the cutting edge 15, which additionally cuts the soil, where leading cracks are formed. The already cut (torn off) soil element is removed next by the frontal surface 7 to the bottom surface of the face. The cutting plate 10 is pushed back and the upper part of step 16 leads cylinder 17 to the back part of case 4 under the action of soil resistance force to the cutting. The process then proceeds cyclically.

The next recommendations for design improvement were also developed to reduce the dynamic loads in the elements [20].

The working element of the ripper-pick (Fig. 11) consists of rack 1 and tip 3 set on it with pin 2. The latter has the wedge-shaped case 4, which has the mounting eye 5 with fixing hole 6, the front 7 and lower 8 surfaces. The lower surface 8 has the «swallow tail» form 9, where the cutting plate 10 is inserted, which has the «swallow tail» protrusion 11 on top. The bush 11, whose surfaces are equidistant surfaces of the groove 9 is inserted into the groove 9 between the plate protrusion 10. The bush 11 is made of anti-friction material and abuts the back part against the limiting stop 12 of the lower surfaces 8. The cutting plate 10 has a lower surface 13 and a front inclined surface 14, which is at the intersection from the cutting edge 15.

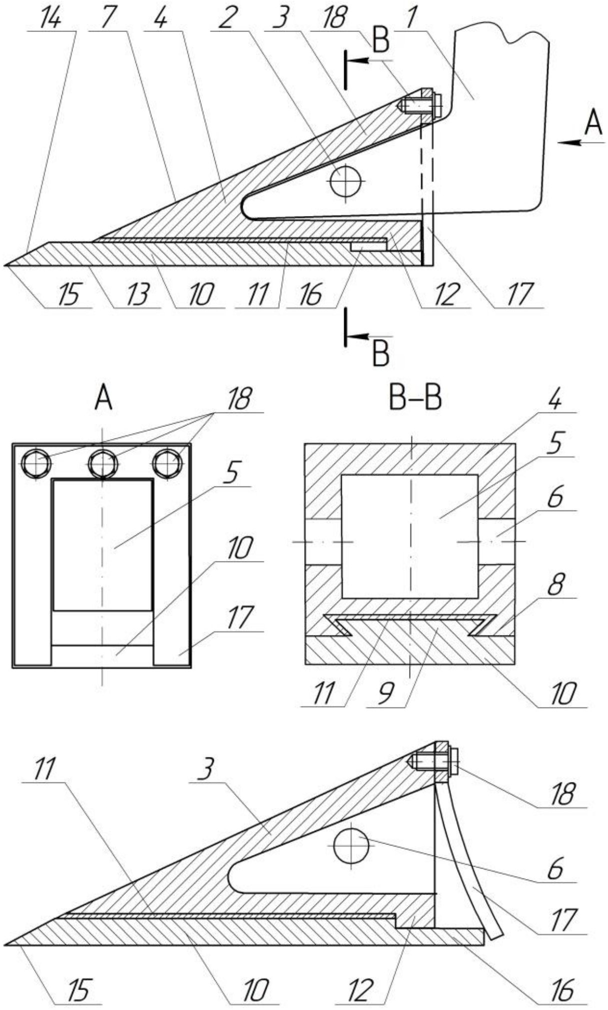

Fig. 11. Working element of ripper-pick

ISSN(online)2709-6149. Mining, constructional, road and melioration machines, 102, 2023, 49-57

Step 16 is made in the back part of plate 10, her upper part has the ability to rest against stop 12, and the lower part has the ability to go beyond the back dimensions of case 4. U-shaped spring 17 is attached to the back part of case 4, the crossbar is attached to case 4 by bolts 18, and the spring struts 17 rest against the lower part of step 16.

The working element of the ripper-pick operates as follows. The soil resistance force to cutting acts on the cutting edge and pushes the cutting plate back to the limit stop when the tip interacts with frozen soil.

The lower part of the step elastically deforms the spring. The soil is crumpled by the frontal and front inclined surfaces when the tip is further inserted into the soil.

As a result, the soil element is separated. The soil resistance to cutting is significantly reduced at this moment. The spring sharply pushes forward the plate with the cutting edge, which additionally cuts the soil, where it forms leading cracks. The cut (torn off) soil element is removed from the frontal surface to the bottom surface of the face.

The cutting plate again moves to the limiting stop under the influence of soil resistance to cutting, where it compresses the spring with the step lower part. The process then proceeds cyclically.

Machines with traditional working elements cannot provide the necessary rate of increase in labor productivity in construction because of the large volumes of earthmoving works, including in the winter period [17, 20–23].

The problem solution lies in establishing the process regularities of the soil massif developed with the ripper, the tip of which is equipped the cutting edge with a pneumatic accumulator. As a result, the accumulation of potential energy is ensured with its further transformation into kinetic energy and direction into the soil massif at its compaction.

The process of energy accumulation and transformation occurs with the tip that has the next design (Fig. 12): a stand with tip 1, which has the movable cutting edge 2, connected by finger 3 to pneumatic cylinder 5 rod 4, which moves the cutting edge 2 by L distance.

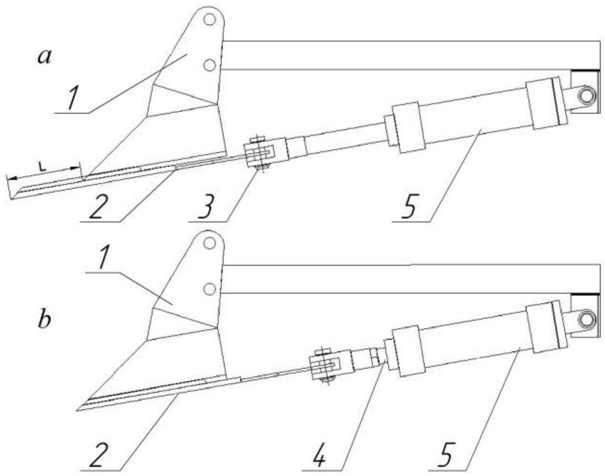

Fig. 12. Tip with cutting edge on the pneumatic cylinder: (*a*) working position with cutting edge, (*b*) sharp knife

CONCLUSIONS

A review and analysis of the existing structures for ripping working elements prove that a promising direction for its improvement is the use of vibratory-percussion executive elements. These elements work on the principle of dynamic energy accumulation, with its subsequent use for useful purposes.

We found that a perspective direction in soil destruction is the superposition principle of the impact on the working medium of several factors concurrently for this, such as static and dynamic loads. This is due to the energy accumulation by the pneumatic accumulator with subsequent use to create a high-speed power impulse on the cutting edge to ensure the preliminary formation of the compressed zone in the soil massif. As a result, this will lead to the power intensity reduction of the static load on the soil element separation.

REFERENCES

1. **Khmara L. A., Kravets S. V., Nichke B. B., Nazarov L. V., Skobluk M. P., Nikitin V. H.** (2010). Mashyny dlia zemlianykh robit [Machines for earthworks]. Rivne – Dnipropetrovsk – Kharkiv, 557. - *(in Ukrainian).*
2. **Balaka M. M., Antonkov M. O.** (2014). Analiz metodiv, zasobiv i tekhnolohii intensyfikatsii vykonannia zemlianykh robit na merzlykh gruntakh [Analysis of the methods, means and technologies intensification of earthworks on the frozen soils]. Sovremennyye innovatsion-

nyye tekhnologii podgotovki inzhenernykh kadrov dlya gornoy promyshlennosti i transporta 2014 [Contemporary innovation technique of the engineering personnel training for the mining and transport industry 2014]: International Conference Proceedings (March 27–28, 2014). Dnepropetrovsk, National Mining University, 147–156. - *(in Ukrainian)*.

3. **Gorbatiuk Ie., Teteriatnyk O., Prystailo M.** (2015). Obgruntuvannia konstruktyvnykh osoblyvostei nyzkoenerhoiemnykh dynamichnykh robochykh orhaniv ta navisok zemleryinykh mashyn [Design features justification of low-energy dynamic working elements and attachments of earthmoving machines]. Girnychi, budivelni, dorozhni ta melioratyvni mashyny [Mining, constructional, road and melioration machines], No.85, 99–103. - *(in Ukrainian)*.
4. **Balaka M., Gorbatyuk Ie., Mishchuk D., Prystailo M.** (2021). Characteristic properties of support surfaces for self-propelled scrapers motion. Fundamental and applied research in the modern world: Abstracts of the 6th International scientific and practical conference (January 20–22, 2021). Boston, USA, 53–58.
5. **Teteriatnyk O., Balaka M.** (2021). Analiz shliakhiv zabezpechennia enerhonezalezhnosti budivelnoi tekhniky z vykorystanniam vidnovliuvalnykh dzherel enerhii [Analysis of ways to ensure the energy independence of construction equipment using renewable energy sources]. Girnychi, budivelni, dorozhni ta melioratyvni mashyny [Mining, constructional, road and melioration machines], No.97, 24–35. https://doi.org/10.32347/gbdmm2021.97.0301. - *(in Ukrainian)*.
6. **Blokhin V. S., Malich M. H.** (2009). Osnovni parametry tekhnolohichnykh mashyn. Mashyny dlia zemlianykh robit [Basic parameters of technological machines. Machines for earthworks]. Kyiv: Vyscha shkola. Part 2, 455. - *(in Ukrainian)*.
7. **Balaka M. M.** (2012). Tendentsii rozvytku kolisnykh zemleryino-transportnykh mashyn [Development trends of wheeled earth-moving and transport machines]. Abstracts of the Scientific Conference of young scientists, postgraduates and students (November 6–8, 2012). Kyiv: Kyiv National University of Construction and Architecture, Part 1, 83–84. - *(in Ukrainian)*.
8. **Balaka M., Zozulya E.** (2017). Excavator with active working element. Build Master Class – 2017: International Scientific and Practical Conference Proceedings (28 November – 01 December, 2017). Kyiv, 269–270.
9. **Pelevin L. Ye., Lavryk S. V., Karpenko M. M., Prystailo M. O.** (2013). Navantazhennia na robochyi orhan vidvalnoho typu [Load on the working element of dump type]. Tekhnika budivnytstva, (30), 4–10. - *(in Ukrainian)*.
10. **Khmara L. A., Kolisnyk M. P., Stanevskyi V. P.** (1992). Modernizatsiia ta pidvyschennia produktyvnosti budivelnykh mashyn: Monohrafiia [Modernization and productivity improvement of construction machines: Monograph]. Kyiv: Budivelnyk, 152. - *(in Ukrainian)*.
11. **Pelevin L. Ye., Prystailo M. O.** (2011). Vyznachennia pratsezdatnosti robochykh orhaniv zemleryinykh mashyn [Efficiency determination of working elements for earthmoving machines]. Girnychi, budivelni, dorozhni ta melioratyvni mashyny [Mining, constructional, road and melioration machines], No.77, 96–100. - *(in Ukrainian)*.
12. **Gorbatyuk Ie., Mishchuk D., Balaka M.** (2022). Development machines of boring working organs is with the causative vibroagent of vertical vibrations. Theoretical and science bases of actual tasks: Proceedings of the XXIII International Scientific and Practical Conference (June 14–17, 2022). Lisbon, Portugal, 585–587.
13. **Gorbatyuk Ie., Balaka M., Mishchuk D.** (2021). Information model of bulldozer-looser movement. The world of science and innovation: Abstracts of the 7th International scientific and practical conference (February 10–12, 2021). London, United Kingdom, 54–59.
14. **Pelevin L. Ye., Balaka M. M., Prystailo M. O., Machyshyn H. M., Arzhaiev H. O.** (2015). Teoretychni osnovy vzaiemodii pruzhno-deformovanykh vykonavchykh elementiv budivelnoi tekhniky i robochoho seredovyscha z vrakhuvanniam termoreolohichnykh protsesiv: Monohrafiia [Interaction theoretical foundations of elastically deformed executive elements for construction equipment and working medium taking into account thermorheological processes: Monograph]. Kyiv, Interservis, 232. - *(in Ukrainian)*.
15. **Arzhaiev H. O., Balaka M. M., Pelevin L. Ye., Tsepliaiev A. S.** (2010). Prystrii dlia doslidzhennia vnutrishnikh napruzhen u gruntovomu napivprostori [Device for internal stresses research in the soil half-space]. Patent 50440 U Ukraine, IPC G01L1/00, E02D1/00. No. u200912724, Publ. 10.06.2010, Bulletin No. 11. - *(in Ukrainian)*.
16. **Rashkivskyi V. P., Balaka M. M.** (2021). Vynakhidnytsko-poshukova robota u naukovii diialnosti ta mizhnarodne spivrobitnytstvo [Inventive and research work in scientific activity

and international cooperation]. Kyiv, 44. - *(in Ukrainian)*.
17. **Pelevin L. Ye., Prystailo M. O.** (2010). Ruinuvannia gruntiv ta hirskykh porid deformatorom z konsolnoiu rizhuchoiu kromkoiu [Destruction of soils and rocks by deformer with cantilever cutting edge]. Girnychi, budivelni, dorozhni ta melioratyvni mashyny [Mining, constructional, road and melioration machines], N0.75, 62–66. - *(in Ukrainian)*.
18. **Pelevin L. Ye., Prystailo M. O.** (2012). Obgruntuvannia vyboru heometrychnykh ta dynamichnykh parametriv modeliuvannia rizannia gruntu nakonechnykom z konsolliu [Choice justification of geometric and dynamic parameters for modeling soil cutting with cantilever tip]. Tekhnika budivnytstva, (28), 70–75. - *(in Ukrainian)*.
19. **Pelevin L. Ye., Prystailo M. O.** (2008). Inertsiinyi robochyi orhan rozpushnyka [Inertial working element of ripper]. Patent 29536 U Ukraine, IPC E02F 5/10. No. u200711748, Publ. 10.01.2008, Bulletin No. 1. - *(in Ukrainian)*.
20. **Pelevin L. Ye., Prystailo M. O., Prystailo T. Yu.** (2006). Robochyi orhan rozpushnyka [Working element of ripper]. Patent 16532 U Ukraine, IPC E02F 5/30. No. u200601446, Publ. 15.08.2006, Bulletin No. 8. - *(in Ukrainian)*.
21. **Pelevin L. Ye., Prystailo M. O.** (2010). Pulsuiuchyi robochyi orhan rozpushnyka [Pulsating working element of ripper]. Patent 53150 U Ukraine, IPC E02F 5/30. No. u201003752, Publ. 27.09.2010, Bulletin No. 18. - *(in Ukrainian)*.
22. **Mischuk D. O., Volianiuk V. O., Prystailo M. O.** (2019). Vidval buldozera z pulsuiuchymy rozpushuvalnymy zubamy [Bulldozer blade with pulsating ripping teeth]. Patent 133944 U Ukraine, IPC E02F 3/76. No. u201811801, Publ. 25.04.2019, Bulletin No. 8. - *(in Ukrainian)*.
23. **Pelevin L., Gorbatiuk Ie., Prystailo M., Melnychenko B.** (2020). Eksperymentalni doslidzhennia zahlyblennia zuba rozpushnyka pry riznykh shvydkostiakh peremischennia bazovoi mashyny [Experimental dosage of the loosening of the tooth of the rocket when changing the base of machine]. Girnychi, budivelni, dorozhni ta melioratyvni mashyny [Mining, constructional, road and melioration machines], No.97, 24–35. https://doi.org/10.32347/gbdmm2020.95.0401. - *(in Ukrainian)*.

Інноваційні шляхи вдосконалення машин для підготовчих робіт з огляду на потреби сучасної будівельної індустрії

Микола Пристайло, Максим Балака, Валентин Можарівський, Володимир Драчук, Ігор Гонта

Київський національний університет будівництва і архітектури

Анотація. При виконанні підготовчих робіт основною машиною є бульдозер-розпушник. Створення високопродуктивних машин здійснюється за двома напрямками: виробництво принципово нових робочих органів та машин на основі використання досягнень фундаментальних наук і вдосконалення наявних робочих органів, та машин традиційного типу, що знаходяться в експлуатації.

Перспективним напрямом розвитку машин, призначених для розпушування мерзлих та міцних ґрунтів, є створення робочих органів розпушувачів-кайлувальників, які надавали б можливість значно підвищити продуктивність виконання розпушувальних робіт шляхом раціонального використання сили тяги базової машини, застосовуючи принцип суперпозицій впливу на робоче середовище декількох чинників одночасно, таких як статичне та динамічне навантаження, завдяки акумулюванню енергії з подальшим її використанням для створення швидкісного силового імпульсу на різальній кромці для забезпечення попереднього утворення стисненої зони в масиві, що призведе до зменшення енергоємності статичного навантаження для відокремлення елементу ґрунту.

Ключові слова: бульдозер-розпушник, зменшення енергоємності, принцип суперпозицій, машини для підготовчих робіт.